(19)日本国特許庁（ＪＰ）　(12)特　許　公　報（Ｂ２）　(11)特許番号
特許第3191581号
(P3191581)
(45)発行日　平成13年７月23日(2001.7.23)　(24)登録日　平成13年５月25日(2001.5.25)

(51)Int.Cl.⁷	識別記号	Ｆ Ｉ	
Ｆ０２Ｍ　43/04		Ｆ０２Ｍ　43/04	
Ｆ０２Ｂ　47/02		Ｆ０２Ｂ　47/02	
Ｆ０２Ｄ　19/12		Ｆ０２Ｄ　19/12	Ａ
Ｆ０２Ｍ　25/022		Ｆ０２Ｍ　61/10	Ｑ
61/10		61/18	３２０Ｚ

請求項の数４(全 12 頁)　最終頁に続く

(21)出願番号　特願平6－280645

(22)出願日　平成６年11月15日(1994.11.15)

(65)公開番号　特開平8－144883
(43)公開日　平成８年６月４日(1996.6.4)
審査請求日　平成10年１月22日(1998.1.22)

(73)特許権者　000006286
三菱自動車工業株式会社
東京都港区芝五丁目33番８号
(72)発明者　小野　徳昭
東京都港区芝五丁目33番８号　三菱自動車工業株式会社内
(74)代理人　100092978
弁理士　真田　有

審査官　八板　直人

(56)参考文献　特開　平３－11148（ＪＰ，Ａ）
実開　平２－7358（ＪＰ，Ｕ）
実開　平４－47159（ＪＰ，Ｕ）
特表　平７－506647（ＪＰ，Ａ）

最終頁に続く

(54)【発明の名称】　水噴射弁及び水噴射弁付ディーゼルエンジン

1

(57)【特許請求の範囲】
【請求項１】　エンジンの燃焼室に設けられる噴射弁において、
該噴射弁の本体内を摺動する針弁と、
該本体又は該針弁に設けられた燃料通路と、
該針弁の作動により該燃料通路と連通される上記本体又は該針弁に設けられた該燃料を噴射する燃料噴射孔と、
該本体又は該針弁に設けられた水通路と、
該針弁の作動により該水通路と連通され上記本体又は針弁に設けられた該水を噴射する水噴射孔とを備え、
該燃料噴射孔と該水噴射孔が各々独立して同一の噴射弁に設けられると共に、該噴射弁の該針弁が燃料圧力の上昇により摺動すると先ず燃料噴射孔が開口し、次いで該針弁が更に摺動すると該水噴射孔が開口するように構成され、該水噴射孔は上記燃料噴射孔が指向する燃料噴射

2

位置より上記燃焼室に発生するスワールの下流側に指向し、且つ上記燃料噴射孔より噴射され燃焼し火炎伝播されて高温燃焼している部分に該水が噴射されるように設けられたことを特徴とする水噴射弁。
【請求項２】　該噴射弁の横断面の投影面において、該水噴射孔が該燃料噴射孔と間隔を存して設けられると共に、該燃料噴射角度に対する該水噴射角度とのずれ角度の範囲が略１５度～４５度に構成されたことを特徴とする、請求項１記載の水噴射弁。
【請求項３】　エンジンの燃焼室に噴射弁をそなえたディーゼルエンジンおいて、
該噴射弁の本体内を摺動する針弁と、
該本体又は該針弁に設けられた燃料通路と、
該針弁の作動により該燃料通路と連通される上記本体又は該針弁に設けられた該燃料を噴射する燃料噴射孔と、

該本体又は該針弁に設けられた水通路と、
該針弁の作動により該水通路と連通され上記本体又は針弁に設けられた該水を噴射する水噴射孔と、
上記燃料通路に接続された燃料供給装置と、
上記水通路に接続された水供給装置と、
上記エンジンのクランク角信号，負荷信号，及び気温，冷却水温度，エンジンルーム温度等の雰囲気温度の少なくとも一つの該信号の入力により少なくとも水噴射を制御する制御装置とを備え、
該燃料噴射孔と該水噴射孔が各々独立して同一の噴射弁に設けられると共に、該噴射弁の該針弁が燃料圧力の上昇により摺動すると先ず燃料噴射孔が開口し、次いで針弁が更に摺動すると該水噴射孔が開口するように構成され、該水噴射孔の噴射方向は上記燃料噴射孔が指向する燃料噴射位置より上記燃焼室に発生するスワールの下流側に指向し、且つ上記燃料噴射孔より噴射された燃料が燃焼し火炎伝播されて高温燃焼している部分に該水が噴射されるように設けられたことを特徴とする、水噴射弁付ディーゼルエンジン。

【請求項４】　エンジンの燃焼室に噴射弁をそなえたディーゼルエンジンおいて、
該噴射弁の本体内を摺動する針弁と、
該本体又は該針弁に設けられた燃料通路と、
該針弁の作動により該燃料通路と連通される上記本体又は該針弁に設けられた該燃料を噴射する燃料噴射孔と、
該本体又は該針弁に設けられた水通路と、
該針弁の作動により該水通路と連通され上記本体又は針弁に設けられた該水を噴射する水噴射孔と、
上記燃料通路に接続された燃料供給装置と、
上記水通路に接続された水供給装置と、
上記エンジンのクランク角信号，負荷信号，及び気温，冷却水温度，エンジンルーム温度等の雰囲気温度の少なくとも一つの該信号の入力により少なくとも水噴射を制御する制御装置とを備え、
該制御装置は、該針弁を該針弁の軸線を中心に回動させて、該燃料噴射孔と該水噴射孔との噴射方向のずれ角度を調整する回動手段を有し、該水噴射孔の噴射方向は上記燃料噴射孔が指向する燃料噴射位置より上記燃焼室に発生するスワールの下流側に指向し、且つ上記燃料噴射孔より噴射された燃料が燃焼し火炎伝播されて高温燃焼している部分に該水が噴射されるように設けられたことを特徴とする、水噴射弁付ディーゼルエンジン。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は水と燃料とを噴射する水噴射弁及び水噴射弁付ディーゼルエンジンに関する。

【０００２】

【従来の技術】ディーゼルエンジンの排ガス中の窒素酸化物（ＮＯｘ）を低減させるために、従来から燃料中に水を混入させたり、エマルジョン燃料を使用したり、燃料とは別に燃料室内に水を独立して噴射されるディーゼルエンジン等が有効であることは周知である。

【０００３】この種のディーゼルエンジンの従来例は、例えば水噴射ディーゼルエンジンの特開平４－２７７５７号公報がある。該特開平４－２７７５７号公報記載の水噴射ディーゼルエンジンは図９及び図１０に示すように、水供給ポンプ１８が休止期間中に、制御弁１６はコントロール装置２０を介して所定の期間、開弁状態に保持され所定量の水を供給管１５を介して燃料・水噴射弁４０に送り込まれている。

【０００４】この時、燃料噴射ポンプ本体３の逆止弁調整弁７の開弁圧力Ｐａ及び水の逆止弁１３の開弁圧をＰｒとする時、針弁１１の開弁圧Ｐｏに対して、Ｐｏ＞Ｐａ，Ｐｏ＞Ｐｒとなっているので、供給された水は逆止弁１３を経て水通路３０および合流部３１を通り燃料通路２２内に流入している。燃料通路２２内の合流部３１より上流側、即ち燃料噴射ポンプ３本体側にある燃料は、燃料噴射ポンプ本体３の方向に燃料噴射管８を通って押し戻され、逆止調整弁７を押し開いてプランジャ室に逆流する。

【０００５】その結果、図１０に示すように燃料水噴射弁４０内には、燃料溜部１２の容積Ｖ２ および合流部３１から燃料溜部１２までの燃料通路２２の容積Ｖ１ の和であるＶ１ ＋Ｖ２ の容積燃料で満たされ、上記合流部３１の上流側の燃料通路２２内には所定量の水が満たされ、更にその上流には再び燃料が満たされた状態となっているものである。

【０００６】この状態から燃料ポンプのプランジャ４が上昇して燃料の圧縮が開始されると、燃料噴射管８，燃料通路２２および燃料溜部１２内の圧力が上昇し、針弁１１の開弁圧Ｐ。以上になると針弁１１が開かれる。針弁１１が開弁圧Ｐｏに達すると、図１０および図１１のように燃料・水噴射弁４０の噴孔１０からは、先ず燃料溜部１２および燃料通路２２内の合流部までの容積（Ｖ１＋Ｖ２）の燃料（イ）が噴射され、続いて上記の所定量供給されていた水（ロ）が噴射され、最後に残りの燃料（ハ）が全量噴射される。

【０００７】その後、上記燃料ポンプのプランジャ４が下降するので、燃料溜部１２内の圧力が下降し、針弁１１が閉まると共に、上記プランジャによる燃料の圧送を行わない休止期間になり、その後は上記で説明した水供給ポンプ１８の作動により水が上記と同様の行程を経て、燃料・水噴射弁４０に送り込まれる構造になっている。

【０００８】

【発明が解決しようとする課題】しかしながら、この特開平４－２７７５７号公報記載の技術では燃料・水噴射弁に設けられた一つの噴孔１０により、図１０に示したように上記１回の噴射で燃料（イ），水（ロ），燃料（ハ）の順で同一方向の同一位置に噴射することにな

る。

【０００９】従って、最初に噴射された燃料（イ）はスワールにより下流側に流されながら、着火され火炎伝播されていくので、燃焼温度は該噴射された位置近傍の燃焼温度は低温で上記下流に行くに従って、徐々に上昇し、高温で燃焼している部分は上記下流側である。従って、水（ロ）の噴射は上記のように同一位置である低温で燃焼をしているところに向けられているので失火する虞ががあり、燃料噴射が燃料→水→燃料と間欠的になるため、失火した場合にはＨＣ，ＣＯ，黒煙が排ガスとして増加され排出されることになる。

【００１０】又、上記公報記載の技術の燃料及び水の噴射期間（時間）は、図１１で示されているように、従来の燃料噴射量（（イ）+（ハ））と略同量の水（ロ）が噴射されることになるので、従来燃料のみの噴射と比較して約２倍となり長くなる。該噴射期間（時間）が長くなると、燃料室内の圧力が下り始め、且つ温度が下がったところに上記最後の燃料（ハ）が噴射されることになるので、該燃焼がしにくくなり、未燃焼ガスや黒煙が発生し易く、更に燃費が悪くなる。

【００１１】本発明は上記課題に鑑みて提案されたものであって、上記燃料室内の燃料を連続的に燃焼させるように燃料噴射孔と水噴射孔を別々に設けて噴射を行い、上記高温燃焼部分に燃料を噴射しながら水を噴射し、該高温燃焼部分の該燃焼温度を下げ、且つ上記低温燃焼部分の温度は出来るだけ下げないように、燃料の該噴射孔と水噴射孔の噴射角度をずらすことによって、ＮＯｘ，ＨＣ，ＣＯ，および黒煙の発生を低減ができるようにして上記課題を解消することを目的としている。

【００１２】

【課題を解決するための手段】このため、請求項１記載の本発明の水噴射弁は、エンジンの燃焼室に設けられる噴射弁において、該噴射弁の本体内を摺動する針弁と、該本体又は該針弁に設けられた燃料通路と、該針弁の作動により該燃料通路と連通される上記本体又は該針弁に設けられた該燃料を噴射する燃料噴射孔と、該本体又は該針弁に設けられた水通路と、該針弁の作動により該水通路と連通され上記本体又は針弁に設けられた該水を噴射する水噴射孔とを備え、該燃料噴射孔と該水噴射孔が各々独立して同一の噴射弁に設けられると共に、該噴射弁の該針弁が燃料圧力の上昇により摺動すると先ず燃料噴射孔が開口し、次いで該針弁が更に摺動すると該水噴射孔が開口するように構成され、該水噴射孔は上記燃料噴射孔が指向する燃料噴射位置より上記燃焼室に発生するスワールの下流側に指向し、且つ上記燃料噴射孔より噴射され燃焼し火炎伝播されて高温燃焼している部分に該水が噴射されるように設けられたことを特徴としている。

【００１３】請求項２記載の本発明の水噴射弁は、請求項１記載の構成において、該噴射弁の横断面の投影面において、該水噴射孔が該燃料噴射孔と間隔を存して設けられると共に、該燃料噴射角度に対する該水噴射角度とのずれ角度の範囲が略１５度～４５度に構成されたことを特徴としている。

【００１４】また、請求項１又は２記載の構成において、一端が該針弁と該本体の内周壁で形成される燃料室に連通され、他端が該針弁に設けられた燃料噴射孔と連通される該針弁に形成された上記燃料通路と、一端が該本体に設けられた水供給通路と連通され他端が該針弁に設けられた水噴射孔と連通される該針弁に設けられた水通路と、該針弁と該本体の内壁との間に設けられ該針弁を上記燃料噴射孔と水噴射孔を閉じる方向に付勢する弾性部材とを備えることもできる（態様１）。

【００１５】また、上記態様１記載の構成において、該水通路を該本体に設けることもできる（態様２）。また、請求項１又は２記載の構成において、該針弁の作動により開閉され上記燃料通路と連通される該本体の先端部に設けられた燃料噴射孔と、一端が該針弁の先端部と該本体の内周壁との当接部に設けられた燃料溜部に連通し他端が上記本体に設けられた上記燃料通路と連通される上記燃料供給通路に連通される燃料通路と、該燃料噴射孔より上方位置の該本体に設けられた該水噴射孔と、一端が上記本体内に設けられた該水供給通路に連通され他端が該燃料噴射孔と該水噴射孔との間の位置に供給孔を有する該針弁に設けられた該水通路と、該針弁と上記本体との間に設けられ該針弁が上記燃料噴射孔及び水噴射孔を閉じる方向に付勢する弾性部材とを備えることもできる（態様３）。

【００１６】また、上記態様３記載の構成において、該燃料通路を該本体に設けることもできる（態様４）。また、請求項１，上記態様３，４のいずれかに記載の構成において、該燃料噴射孔と水噴射孔との噴射方向の該ずれ角度が異なるように該本体に設けられた複数個の水噴射孔と、該針弁を該針弁の軸線を中心に回動せしめ、上記水供給孔と該複数個の水噴射孔とを選択して連通させる該針弁の回動手段とを備えることもできる（態様５）。

【００１７】また、上記態様５記載の構成において、上記針弁の回動手段は、該針弁の頭部に設けられたピニオンギヤを有し該ピニオンギヤと係合するラックとにより構成される回転位置可変部材で形成することもできる（態様６）。請求項３記載の本発明の水噴射弁付ディーゼルエンジンは、燃焼室に噴射弁をそなえたディーゼルエンジンにおいて、該噴射弁の本体内を摺動する針弁と、該本体又は該針弁に設けられた燃料通路と、該針弁の作動により該燃料通路と連通される上記本体又は該針弁に設けられた該燃料を噴射する燃料噴射孔と、該本体又は該針弁に設けられた水通路と、該針弁の作動により該水通路と連通され上記本体又は針弁に設けられた該水を噴射する水噴射孔と、上記燃料通路に接続された燃料

供給装置と、上記水通路に接続された水供給装置と、上記エンジンのクランク角信号，負荷信号，及び気温，冷却水温度，エンジンルーム温度等の雰囲気温度の少なくとも一つの該信号の入力により少なくとも水噴射を制御する制御装置とを備え、該燃料噴射孔と該水噴射孔が各々独立して同一の噴射弁に設けられると共に、該噴射弁の該針弁が燃料圧力の上昇により摺動すると先ず燃料噴射孔が開口し、次いで針弁が更に摺動すると該水噴射孔が開口するように構成され、該水噴射孔の噴射方向は上記燃料噴射孔が指向する燃料噴射位置より上記燃焼室に発生するスワールの下流側に指向し、且つ上記燃料噴射孔より噴射された燃料が燃焼し火炎伝播されて高温燃焼している部分に該水が噴射されるように配設されたことを特徴としている。請求項４記載の本発明の水噴射弁付ディーゼルエンジンは、燃焼室に噴射弁をそなえたディーゼルエンジンにおいて、該噴射弁の本体内を摺動する針弁と、該本体又は該針弁に設けられた燃料通路と、該針弁の作動により該燃料通路と連通される上記本体又は該針弁に設けられた該燃料を噴射する燃料噴射孔と、該本体又は該針弁に設けられた水通路と、該針弁の作動により該水通路と連通され上記本体又は針弁に設けられた該水を噴射する水噴射孔と、上記燃料通路に接続された燃料供給装置と、上記水通路に接続された水供給装置と、上記エンジンのクランク角信号，負荷信号，及び気温，冷却水温度，エンジンルーム温度等の雰囲気温度の少なくとも一つの該信号の入力により少なくとも水噴射を制御する制御装置とを備え、該制御装置は、該針弁を該針弁の軸線を中心に回動させて、該燃料噴射孔と該水噴射孔との噴射方向のずれ角度を調整する回動手段を有し、該水噴射孔の噴射方向は上記燃料噴射孔が指向する燃料噴射位置より上記燃焼室に発生するスワールの下流側に指向し、且つ上記燃料噴射孔より噴射された燃料が燃焼し火炎伝播されて高温燃焼している部分に該水が噴射されるように配設されたことを特徴としている。

【００１８】また、請求項３記載の構成において、上記燃料噴射孔のみを有する該燃料噴射弁と水噴射孔のみを有する該水噴射弁をそれぞれ独立して設けることもできる（態様７）。また、請求項３又は上記態様７記載の構成において、該エンジンの始動時，アイドル回転時，低負荷時，着火しにくい該エンジンの上記雰囲気温度時には水噴射が行なわれず、該エンジンの中負荷時から高負荷時に上記制御装置により制御され上記燃料噴射と水噴射が行われ連続的に燃焼されるように構成することもできる（態様８）。

【００１９】また、請求項３，上記態様７，８のいずれかに記載の構成において、該水の噴射量が、該エンジン負荷に応じて燃料１００％に対して０乃至６０％好ましくは４０乃至６０％噴射されるように上記制御装置により制御されるように構成することもできる（態様９）。

【００２０】

【作用】上述の請求項１記載の本発明の水噴射弁では、該燃焼室に設けられる噴射弁において、上記燃料噴射孔と水噴射孔を別々に設け、該燃料噴射孔から噴射された燃料が着火し上記燃焼室に発生するスワールの下流側に火炎伝播され高温になっている燃焼部分に、該燃料を噴射させながら該水噴射孔から水が噴射できるように構成されているので、該燃焼が連続的に燃焼することができる。

【００２１】上記のように燃料の噴孔と水の噴射孔をずらしたので該高温燃焼部分に上記燃料を噴射させながら該水を噴射し、該高温燃焼部分の燃焼温度を下げると共に、該燃焼の略低温燃焼部分には水を噴射せず温度は下げないようにすることができる。又、上記のように該燃料の噴射期間中の所望の時期に上記水噴射が行われるので、該燃料噴射期間がが長くなることはない。

【００２２】従って本発明ではＨＣ，ＣＯ，黒煙の排出を効果的に低減させることができる。又、同一の上記噴射弁に該燃料噴射孔と水噴射孔を各々独立して配設し、該噴射弁の針弁の作動により、先ず該燃料噴射孔が開口し、その後該水噴射孔が開口するように構成したので、１本の該噴射弁で上記燃料を噴射中の所望の時期に水を噴射することができる。

【００２３】従って、上記燃焼を失火させることなく、ＨＣ，ＣＯ，黒煙の排出を低減させることができ、コストが安価でコンパクトな水噴射弁を形成することができる。請求項２記載の本発明の水噴射弁では、該燃料噴射孔と該水噴射孔の該噴射角のずれ角が略穂１５度～４５度に構成されており、該先行噴射された燃料により上記高温で燃焼している部分に的確に水噴射できるので、失火させることなく該高温燃焼部分の温度を下げることができＮＯｘの発生を低減させることができる。

【００２４】また、上記態様１又は上記態様２記載の構成では、該針弁の該頭部と該本体内周壁との間に燃料室を設け、該燃料室に供給される燃料の圧力により上記弾性部材に抗して該針弁を作動せしめ、該燃料噴射孔を開口し、次いで該水噴射孔を開口するようにしたのでコンパクトに形成され燃料及び水の噴射が容易に行うことができる。

【００２５】また、上記態様３又は上記態様４記載の構成では、上記燃料噴射孔と水噴射孔を該本体に設け、該針弁が該本体内を上方に作動することにより、上記燃料と水の噴射孔を開口するように構成し、該燃料室への該針弁の出し入れをなくしたので、該針弁が該本体内を確実に案内され上記両噴射孔の開閉を円滑に行なうことできる。

【００２６】また、上記態様５又は上記態様６記載の構成では、該燃料噴射孔に対する該水射孔の噴射方向の上記ずれ角が異なるように該本体に設けられた複数個の該水噴射孔と、上記針弁の回動手段で該針弁を回転せしめて、上記針弁の水供給孔と選択的に連通せしめるように

したので、該エンジン負荷や上記スワールの状態に応じて変化する上記高温燃焼部分に的確に該水噴射を行い失火させることなく、該高温燃焼部分の温度を下げることができるので、効果的にＮＯｘの発生を低減させることができる。

【００２７】請求項３記載の水噴射弁付ディーゼルエンジンでは、上記燃料通路に接続された燃料供給装置と、上記水通路に接続された水供給装置と、上記エンジンのクランク角信号，負荷信号，及び気温，冷却水温度，エンジンルーム温度等の雰囲気温度の少なくとも一つの該信号の入力により少なくとも上記水噴射量を制御する制御装置とからなり、該燃料噴射孔と該水噴射孔が各々独立して同一の噴射弁に設けられると共に、該噴射弁の該針弁が燃料圧力の上昇により摺動すると先ず燃料噴射孔が開口し、次いで針弁が更に摺動すると該水噴射孔が開口するように構成され、該水噴射孔の噴射方向は上記燃料噴射孔が指向する燃料噴射位置より上記燃焼室に発生するスワールの下流側に指向し、且つ上記燃料噴射孔より噴射された燃料が燃焼し火炎伝播されて高温で燃焼している部分に該水噴射されるように構成された水・燃料噴射装置を備えているので、上記水と燃料の噴射量、噴射方向及び噴射時期を的確に行なうことができるとともに、失火させることなく良好な燃焼を行わすことができる。請求項４記載の水噴射弁付ディーゼルエンジンでは、エンジンの燃焼室に噴射弁をそなえたディーゼルエンジンおいて、該噴射弁の本体内を摺動する針弁と、該本体又は該針弁に設けられた燃料通路と、該針弁の作動により該燃料通路と連通される上記本体又は該針弁に設けられた該燃料を噴射する燃料噴射孔と、該本体又は該針弁に設けられた水通路と、該針弁の作動により該水通路と連通され上記本体又は針弁に設けられた該水を噴射する水噴射孔と、上記燃料通路に接続された燃料供給装置と、上記水通路に接続された水供給装置と、上記エンジンのクランク角信号，負荷信号，及び気温，冷却水温度，エンジンルーム温度等の雰囲気温度の少なくとも一つの該信号の入力により少なくとも水噴射を制御する制御装置とを備え、該制御装置は、該針弁を該針弁の軸線を中心に回動させて、該燃料噴射孔と該水噴射孔との噴射方向のずれ角度を調整する回動手段を有し、該水噴射孔の噴射方向は上記燃料噴射孔が指向する燃料噴射位置より上記燃焼室に発生するスワールの下流側に指向し、且つ上記燃料噴射孔より噴射された燃料が燃焼し火炎伝播されて高温燃焼している部分に該水を噴射させることができる。

【００２８】また、上記態様７記載の構成では、水噴射ディーゼルエンジンでは、該燃料噴射弁と水噴射弁とを別々に設けたので、該燃料室に配設する時、該燃料噴射孔に対する該水噴射孔の上記相対位置を独自に設定できる自由度があり、効果的な上記水噴射を行うことができる。また、上記態様８又は上記態様９記載の構成では、

上記燃料噴射装置および水噴射装置に配設された上記制御装置により、該水噴射の水量と該水噴射期間が制御され、該エンジンの始動時，アイドル回転時，低負荷時，着火しにくい該エンジンの上記雰囲気温度時には水噴射は行なわれず、該ディーゼルエンジンの中負荷時および高負荷時には上記燃料噴射と共に水噴射が行われるようにしたので、上記燃焼を失火させることなく、上記水と燃料の噴射量、噴射方向及び噴射時期を的確に行なうことができると共に、エンジン出力を低減させることなく効果的にＮＯｘ，ＨＣ，ＣＯ，黒煙の発生を低減させることができる。

【００２９】

【実施例】図１～８について本発明の実施例を説明する。

（第１実施例）図１～３は本発明の第１実施例を示すものであって、図１は本発明の噴射弁を備えた燃料・水噴射装置の説明図、図２は本発明の水噴射弁の噴射孔の作動状態を示す説明図であって、（ａ）は該噴射弁の無噴射状態を示す噴射孔の近傍の説明図、（ｂ）は該噴射弁の燃料噴射状態を示す説明図、（ｃ）は該噴射弁の燃料と水とを同時に噴射している状態を示す説明図である。

【００３０】図３は第１実施例の噴射弁で燃料及び水の噴射角度の関係を示す説明図である。図１に示したように、水噴射弁５０は、上記燃料及び水の噴射量，噴射時期，噴射方向等を制御する制御装置を介して設けられた燃料供給装置及び水供給装置からなる燃料・水噴射装置に接続されている。

【００３１】水噴射弁５０は、本体５２に摺動自在に嵌挿され本体５２の下端のネジ部５２ａに保持部材５２ｂが螺合締結することにより保持された針弁５４と、一端側の頭部５６及び本体５２の内周壁５８で形成される燃料室６０とから形成されている。上記燃料及び水の両噴射が停止している状態を、図１に実線で示したように、一端が燃料室６０に連通され他端が針弁５４の燃料噴射孔６２に連通している燃料通路６４が針弁５４に設けられている。

【００３２】又、一端が燃料室６０に連通され他端が供給管６１，制御装置６３を介して燃料供給装置６６に連接されている燃料供給通路６８が本体５２に設けられている。又、逆止調圧弁７０、供給管７１、制御装置６３を介して水供給装置７２に連通している水供給路７４が本体５２に設けられている。

【００３３】又、水供給路７４の供給孔７６と連通する供給孔７８を一端に有し、他端に針弁５４に設けられた水噴射孔８０に連通している水通路８２が該針弁５４に設けられている。この針弁５４の頭部５６の下面に設けられたリテーナ８４と本体５２の内周の段部に設けられたリテーナ８６との間に介装された弾性体であるスプリング８８により、針弁５４が燃料噴射孔６２、水噴射孔８０が閉塞される方向に付勢され、燃料室６０内のスト

ッパ部９０に当接している。

【００３４】又、上記燃料の制御装置６３は燃料供給管６１に設けられた電磁弁９２及び燃料噴射ポンプ９４に接続されると共に、ディーゼルエンジンのクランク角度センサ６３ａ，該エンジンの負荷センサ６３ｂ，該エンジンの冷却水温度，エンジンルームの温度，気温等の該エンジンの雰囲気温度センサ６３ｃ等からの信号が入力され上記燃料噴射ポンプ９４、電磁弁９２に制御信号を出力し、燃料供給量や燃料噴射時期を制御するコントローラ９６等で構成されている。

【００３５】一方、上記の水制御装置６３も上記燃料の制御装置６３と相違するものは燃料噴射ポンプ９４に代えて水加圧ポンプ９４ａのみであり、その他の構成は実質的に同一である。本実施例の水加圧ポンプ９４ａは燃料噴射ポンプ９４と同様構成の水噴射ポンプ９４に代えることもできる。

【００３６】この水噴射量、該噴射時期が、上記各センサ６３ａ，６３ｂ，６３ｃ，．．．等からの信号をコントローラ９６へ入力し、制御信号として出力されることにより、電磁弁９２，加圧ポンプ９４ａ等が制御され決定されるものである。ここで、ディーゼルエンジンが作動し、図１に示した制御装置６３にディーゼルエンジンのクランク角センサ６３ａ，エンジンの中負荷から高負荷を上記負荷センサ６３ｂ，上記雰囲気温度センサ６３ｃ等からの少なくとも一つの信号が入力され燃料噴射ポンプ９４や電磁弁９２等が制御され、燃料噴射ポンプ９４により燃料タンク９３の燃料が供給管６１、燃料供給通路６８を介して燃料室６０に供給される。

【００３７】燃料室６０の圧力が針弁５４の開弁設定圧より上昇すると針弁５４がスプリング９８の付勢力に抗して針弁５４が下降して図２（ｂ）に示したように、燃料噴射孔６２が開かれるので燃料が噴射される。また、図２において、燃料噴射孔６２と水噴射孔８０は、説明の都合上、互いに１８０度の間隔があるように示したが、この両噴射角の関係は図３に示すようなずれ角Ｋの通りである。

【００３８】以上、本実施例においては、上記燃料供給装置及び水供給装置の燃料及び水の噴射量及び噴射時期を上記制御装置により制御する燃料・水噴射装置について説明したが、これに限定されるものではなく、アクセルペタルと機械的に連係して上記噴射量及び噴射時期を制御する装置も含まれるものである。この関係は後述の第２及び第３実施例においても同様である。

【００３９】この燃料噴射孔６２は図３に示したように、針弁５４の先端部に略等間隔で燃料噴射孔（６２）が設けられており、本実施例の場合は５個の燃料噴射孔が設けられている。図３に斜線で示すように、該燃料噴射孔６２から燃料がＦ１のように噴射されて着火されながら、図示しない燃料室内に発生するスワール方向Ｓに徐々に火炎伝播され燃焼していくが、高温で燃焼している部分Ｆ２は上記燃料が噴射された位置より上記スワールＳの下流側の部分Ｈ２になっている。

【００４０】更に、燃料室の圧力が上昇し針弁５４が図１の二点鎖線及び図２（ｃ）に示したように、下方に摺動し水噴射孔８０が開くと、水タンク９８内の水が上記制御装置６３で制御され上記水供給装置７２から水供給管７１，逆止弁７０、水供給通路７４，水通路８２を介して供給されている水が、上記高温で燃焼されている部分Ｆ２方向に指向して、図３に示したように燃料噴射孔の下流側に設けられた水噴射孔８０より噴射される。

【００４１】図３に示したように、上記５個の燃料噴射孔６２の各々に対してずれ角Ｋ（燃料噴射孔６２中心線Ｈ１に対する水噴射孔８０の中心線Ｈ２のずれ角）が存するように、水噴射孔８０が略同間隔に設けられ水噴射が行われるので、該高温部で燃焼している部分に水噴射が行われ、失火することなく且つ温度が下がり燃焼しながらスワールＳ方向に燃焼し続け良好な燃焼が行われる。

【００４２】この噴射角のずれ角度Ｋはエンジンの大きさや所望のスワールＳの状態に応じて略１５度～４５度に形成されており、従って該高温で燃焼している部分の燃焼温度が的確に下がりＮＯｘ，ＨＣ，ＣＯ，黒煙の発生を低減させることができる。次に、制御装置６３の作動により電磁弁９２や燃料噴射ポンプ９４が制御され、燃料吐出量が減少するとスプリング８８の付勢力で針弁５４が図１に実線で示した方向に戻り頭部５６がストッパ９０に当接して停止する。

【００４３】この時、水供給装置７２から水の供給も制御装置６３の制御により水の供給も遮断され図２（ａ）の状態に戻り、水及び燃料の噴射の１サイクルが終了する。このサイクルの繰り返しが、該エンジンの始動から低負荷，中負荷，高負荷で作動中に行われ、エンジン出力を低減させることなくＮＯｘ，ＨＣ，ＣＯ，黒煙を効果的に低減させることができる。

【００４４】又、該エンジンの無負荷，低負荷、アイドル回転を上記負荷センサ６３ｂが検出したり、エンジン雰囲気温度センサ６３ｃが着火温度以下の温度を検出すると、上記水供給装置７２が作動しないので、該水噴射が行なわれない。一方、該水が無噴射の時には、上記燃料が上記と同様に燃料ポンプ９４から燃料室６０に供給されるが、この時、制御装置６３で制御され針弁５４は図２（ｂ）の位置までしか下降しないので、燃料である軽油のみが噴射され良好な該エンジンの作動が行われる。

【００４５】更に、燃料タンク９３の燃料が燃料ポンプ９４により該燃料室６０に供給され圧力が上昇すると針弁５４が下降し、図１の二点鎖線、図２（ｃ）に示す位置に達するので、水噴射と燃料噴射が上記のように同時に行なわれるものである。次に上記実施例とは型式が異なる他の噴射弁に適用した場合について説明する。

【００４６】（第２実施例）第２実施例を図４～６について説明する。上記第１実施例と同一部位には同一符号を付して説明する。図４に示したように、弁本体５２の先端のサックボリューム１００には燃料噴射孔６２が第１実施例と同様に略等間隔で５個設けられている。

【００４７】この燃料噴射孔６２は本体５２の先端部に設けられ、針弁５４（又は図４に二点鎖線で示した本体５２）に設けられた燃料通路６４に、燃料留部１０２、サックボリューム１００を介して針弁５４の開閉により連通されるように構成されている。更に、燃料通路６４は燃料供給通路６８に接続されており、第１実施例の制御装置６３，燃料供給装置６６に供給管６１を介して接続されている。

【００４８】又、水噴射孔８０ａは、燃料噴射孔６２の上方で、且つ上記針弁５４に設けられた水通路８２の供給孔１０４より上方の、水溜部１０６を介して該本体に設けられている。又、針弁５４は針弁５４の頭部５６と本体５２の室５１の壁６１ａとの間に介装されたスプリング８８の付勢力により燃料噴射孔６２及び水噴射孔８０ａが閉じられるように構成されている。

【００４９】水通路８２の供給孔１０８は本体５２に設けられた水供給通路７４に連通されており、逆止弁７０を介して、第１実施例の供給管７１、制御装置６３，水供給装置７２に接続されている。図４は該エンジンが停止している場合で、燃料及び水がともに無噴射時の状態を示すものである。

【００５０】該エンジンが作動して燃料が燃料供給装置６６から供給管６１，燃料供給通路６８，燃料通路６４を介して燃料溜部１０２に供給され、燃料溜部１０２の圧力が針弁５４の開弁設定圧より高くなると、スプリング８８の付勢力に抗して上方に移動するので、図５（ａ）に示したように、該燃料がサックボリューム１００を介して燃料噴射孔６２より上記第１実施例と同様に図６にＦ１で示したように、噴射され着火しスワールＳ方向に火炎伝播され高温燃焼部分Ｆ２が発生している。

【００５１】一方、更に燃料溜部１０２の圧力が上昇すると針弁５４が上昇し、供給孔１０４が水溜部１０６と連通される。この時、水が第１実施例と同様に水供給装置７２から水供給管７１，逆止弁７０，水供給通路７４，水供給通路８２を介して水溜部１０６に供給されているので、水噴射孔８０ａから、上記高温燃焼部分Ｆ２に向けて図５（ｂ），図６に示したように、上記第１実施例と同様に水噴射が行われる。

【００５２】該高温燃焼部分Ｆ２の温度が下がりＮＯｘ，黒煙，ＨＣ，ＣＯの発生が低減されると共に、失火することなく、該エンジンの作動中この上記噴射サイクルが上記制御装置に制御されて連続的に繰り返されている。その後、該エンジンの図示しないスイッチがＯＦＦされると燃料供給装置６６からの燃料供給が停止されるので燃料溜部１０２の圧力が下がり針弁５４はスプリング８８の付勢力で下降し燃料噴射孔６２及び水噴射孔８０ａを閉じ水及び燃料の噴射が停止され図４に示した状態に復帰する。

【００５３】又、該エンジンの低負荷、アイドル回転時や上記エンジンの雰囲気温度が着火しにくい時には上記制御装置６３の制御により第１実施例と同様に水噴射は行われない。上記第１、第２実施例では上記水噴射と燃料噴射角度のずれ角度が一定に設定されたものであったが、該ずれ角度を可変とした噴射弁について第３実施例として説明する。

【００５４】（第３実施例）第３実施例を図７，図８に従って説明する。先ず、本実施例の該針弁の回動手段について説明するが、上記両実施例と実質的に同一の部位には同一符号を付して説明する。上記燃料噴射孔６２と水噴射孔８０ｂの上記ずれ角度Ｋが図７，図８に示すように、低スワール時に該スワールの状態に応じて水噴射孔８０ｂのずれ角度Ｋより小さいずれ角度Ｋ３，Ｋ４になるように、即ち水噴射孔の中心線がＨ３，Ｈ４になるように、水噴射孔８０ｃ，８０ｄが該本体に設けられており、該針弁５４を該針弁５４の軸線を中心に回動手段２００により回動し、該針弁５４の供給孔１０４を該水噴射孔８０ｂ，８０ｃ，８０ｄに選択的に連通させるように構成したものである。

【００５５】本実施例に使用された該回動手段２００について説明すると、本体５２の中に本体５２の軸線方向へ摺動自在に嵌挿された針弁５４の頭部５６はナット１１０で締結されたリテーナ１１２が設けられている。このリテーナ１１２が上下方向に摺動可能であるが、針弁５４に対して回転することが出来ないように、リテーナ１１２を保持する内室１１４が形成された回転位置可変部材２００ａが設けられている。

【００５６】この回転位置可変部材２００ａは本体５４に設けられた凹部２０２に、針弁５４と共に回動可能に嵌挿されており、回転位置可変部材２００ａの上部はボルト２０１，ナット２０１ａにより、ラック２０４と係合するピニオンギア２０６が固定されている。係止蓋２０３が、回転可変部材２００ａを上記凹部２０２に回転可能に係止するようにボルト２０５で本体５２の上部に固定されている。

【００５７】ラック２０４は係止蓋２０３の開口２０３ａより操作できるようなっている。更に、係止蓋２０３の上部の開口２０３ｂから上記ナット２０１ａで取り付けられた、インジケータ２０７の先端が係止蓋２０３の内周に設けられた図示しない目盛りに指向することにより、上記供給孔１０４と水噴射孔８０ｂ，８０ｃ，８０ｄとの係合状態が分かるようになっている。

【００５８】このピニオンギヤ２０６に係合するラック２０４の作動は、前記制御装置６３に制御され回転できる機構になっており、該燃焼室内が低スワール時にはラック２０４によりピニオンギア２０６が回転し、例えば

上記ずれ角度が小さいＫ４の水噴射孔８０ｃと供給孔１０４とが連通する。従って、上記燃焼室の低スワール時は、第１及び２実施例より火炎伝播が小さく、上記実施例よりやや低温の高温で燃焼している部分に噴射量が制御され水噴射を的確に行なうことができるので、必要以上に燃焼温度を下げることなくＮＯｘの発生を効果的に防止できると共に、失火を防止しＨＣ，ＣＯ，黒煙の発生を低減することができる。

【００５９】尚、本発明の噴射弁は従来公知のどんな形成の噴射弁にも適用できるもので、第１，第２実施例に使用された以外の他の形式でもよく、要するに、上記のように先行して燃料噴射され火炎伝播されて高温で燃焼している部分に、水噴射が行わせることができる構成のものであればよい。又、上記実施例では、いずれも水噴射孔８０と燃料噴射孔６２とを１個の同一の該噴射弁に設けたが、水及び燃料各々専用の合計２本の噴射弁を採用しても同様の作用効果が得られるものである。

【００６０】又、各実施例においては、弾性部材であるスプリング８８は、針弁５４と本体５２の内部の室との間に介装されたが、上記両噴射孔６２，８０を開閉できるものであれば、例えば針弁５４と本体５２の外部の部位との間に介装されるものでも良い。

【００６１】

【発明の効果】上述の請求項１の本発明の水噴射弁によれば、該弁本体内を摺動可能に嵌挿された該針弁からなる該噴射弁において、該燃料噴射孔が指向する該噴射位置より上記スワールの下流側に指向するように該水噴射孔を設けたので、先行して噴射された該燃料が該スワールの下流側で高温で燃焼している部分に、上記燃料噴射と共に上記水噴射を行い、高温燃焼部分の温度を下げ、ＮＯｘの低減を効果的に行うことができると共に、失火させることなくＨＣ，ＣＯ，黒煙の発生を防止することができる。

【００６２】又、該燃料噴射孔と該水噴射孔が同一の噴射弁に設けられたので、コストが安く、且つ構造が簡単にＮＯｘ，ＨＣ，黒煙の発生を低減できる該噴射弁を得ることができる。請求項２の本発明の水噴射弁によれば、該燃料噴射孔に対する該水噴射孔の該噴射のずれ角度が略１５度～４５度に構成されており、該先行噴射された燃料により上記高温で燃焼している部分に的確に水噴射できるので、失火させることなく該高温燃焼部分の温度を下げることができ、ＮＯｘ，ＨＣ，ＣＯ，黒煙の発生を低減させることができる。

【００６３】また、上記態様１又は上記態様２記載の構成のように、該針弁の該頭部と該本体内周壁との間に燃料室を設け、該燃料室に供給される燃料の圧力により上記弾性部材に抗して該針弁を作動せしめ、該燃料噴射孔を開口し、次いで該水噴射孔を開口するようにした場合には、コンパクトで安価に形成され燃料及び水の噴射を容易に行うことができる。

【００６４】また、上記態様３又は上記態様４記載の構成のように、該針弁が該本体内を上方に作動することにより、上記燃料と水の噴射孔を開口するように構成し、該燃焼室の容積を変化させることがない場合には、該エンジン出力を低減させることなくＮＯｘ，ＨＣ，黒煙の発生を防止できる。また、上記態様５又は上記態様６記載の構成のように、該燃料噴射孔に対する該水射孔の上記ずれ角度が、該エンジンの大きさや上記スワールの状態に合わせて、異なるように該本体に設けられた複数個の該水噴射孔と、上記針弁の回動手段で該針弁を回転せしめて、該針弁の該水の供給孔と選択的に連通せしめるようにした場合には、該エンジン負荷や上記スワールの状態に応じて、上記高温燃焼部分に該水噴射を行い失火させることなく、該高温燃焼部分の温度を下げることができるので、効果的にＮＯｘ，ＨＣ，ＣＯ，黒煙の発生を低減させることができる。

【００６５】請求項３記載の水噴射弁付ディーゼルエンジンによれば、上記燃料通路に接続された燃料供給装置と、上記水通路に接続された水供給装置と、上記エンジンのクランク角信号，負荷信号，及び気温，冷却水温度，エンジンルーム温度等の雰囲気温度の少なくとも一つの該信号の入力により少なくとも水噴射を制御する制御装置とからなり、該燃料噴射孔と該水噴射孔が各々独立して同一の噴射弁に設けられると共に、該噴射弁の該針弁が燃料圧力の上昇により摺動すると先ず燃料噴射孔が開口し、次いで針弁が更に摺動すると該水噴射孔が開口するように構成され、該水噴射孔の噴射方向は上記燃料噴射孔が指向する燃料噴射位置より上記燃焼室に発生するスワールの下流側に指向し、且つ上記先行して噴射された燃料が燃焼し火炎伝播されて高温燃焼している部分に該水が噴射されるように構成された水・燃料噴射装置を備えているので、上記燃焼を失火させることなく、上記水と燃料の噴射量、噴射方向及び噴射時期を的確に行なうことができる。請求項４記載の水噴射弁付ディーゼルエンジンによれば、エンジンの燃焼室に噴射弁をそなえたディーゼルエンジンおいて、該噴射弁の本体内を摺動する針弁と、該本体又は該針弁に設けられた燃料通路と、該針弁の作動により該燃料通路と連通される上記本体又は該針弁に設けられた該燃料を噴射する燃料噴射孔と、該本体又は該針弁に設けられた水通路と、該針弁の作動により該水通路と連通され上記本体又は針弁に設けられた該水を噴射する水噴射孔と、上記燃料通路に接続された燃料供給装置と、上記水通路に接続された水供給装置と、上記エンジンのクランク角信号，負荷信号，及び気温，冷却水温度，エンジンルーム温度等の雰囲気温度の少なくとも一つの該信号の入力により少なくとも水噴射を制御する制御装置とを備え、該制御装置は、該針弁を該針弁の軸線を中心に回動させて、該燃料噴射孔と該水噴射孔との噴射方向のずれ角度を調整する回動手段を有し、該水噴射孔の噴射方向は上記燃料噴射孔が指

向する燃料噴射位置より上記燃焼室に発生するスワールの下流側に指向し、且つ上記燃料噴射孔より噴射された燃料が燃焼し火炎伝播されて高温燃焼している部分に該水を噴射させることができるので、上記の燃料噴射孔と該水噴射孔との噴射方向のずれ角度を設計仕様に応じて的確な上記ずれ角を設定することができる。

【００６６】従って、上記ＮＯｘ，ＨＣ，ＣＯ及び黒煙の発生を防止することができると共に、上記燃焼を失火させることないので、該エンジンの出力の向上を図ることができる。また、請求項３記載の構成において、該燃料噴射弁と該水噴射弁を各々独立した該噴射弁として設けた場合には、上記両噴射弁の相対的な上記ずれ角度を任意に設定することができ、効果的な上記水及び燃料の噴射を行なうことができる（態様７）。

【００６７】従って、該エンジンを失火させることなくＮＯｘ，ＨＣ，ＣＯ及び黒煙の発生を防止することができる。また、上記態様８又は上記態様９記載の構成のように、上記制御装置により、上記エンジンのアイドル回転時、低負荷時、着火しにくい該エンジンの上記雰囲気温度時には該水噴射を行なわず、上記中負荷時，高負荷時には上記燃料噴射と共に、該水噴射量を調整しながら、該水噴射を行うことができるようにした場合には、該エンジンを失火させることなくＮＯｘ，ＨＣ，ＣＯ及び黒煙の発生を防止することができる。

【００６８】又、上記噴射される燃料１００％に対して０～６０％好ましくは４０～６０％の水が噴射されるように該制御装置により制御されるようにした場合には、安定した該エンジンの作動ができると共に、上記失火させることなくＮＯｘ，ＨＣ，黒煙の発生を低減し、且つ該エンジンの出力を向上させることができる。

【図面の簡単な説明】

【図１】本発明の第１実施例を示す水・燃料の噴射の構成を示す説明図である。

【図２】図１の水噴射弁の作動状態を示す説明図であり、（ａ）は無噴射時を示す説明図、（ｂ）は燃料が噴射されている状態を示す説明図、（ｃ）は水及び燃料が噴射されている状態を示す説明図である。

【図３】図２（ｃ）の３Ａ－３Ａ線に沿う横断面図であり、該第１実施例の燃料と水の噴射方向及びこの両者の噴射のずれ角度を示す説明図である。

【図４】本発明の第２実施例を示す該水噴射弁の縦断面を示す無噴射時の説明図である。

【図５】図４の水噴射弁の作動状態を示す説明図であり、（ａ）は燃料噴射時の状態を示す説明図であり、（ｂ）は水と燃料が噴射されている状態を示す説明図である

【図６】図５（ｂ）の６Ａ－６Ａ線に沿う横断面図であり、第２実施例の燃料と水の噴射方向及びこの両者の噴射方向のずれ角度を示す説明図である。

【図７】本発明の第３実施例を示す水噴射弁の縦断面を示す説明図である。

【図８】図７の８Ａ－８Ａ線に沿う横断面を示し、図３と同様の説明図である。

【図９】従来の燃料・水噴装置の構成を示す説明図である。

【図１０】図９の燃料・水噴射弁の縦断面図である。

【図１１】図９の燃料・水噴射装置による該噴射状況を示す説明図である。

【符号の説明】

３	燃料噴射ポンプ本体
４	プランジャ
７	逆止調圧弁
８	燃料噴射管
１０	噴孔
１１	針弁
１２	燃料溜部
１３	水の逆止弁
１８	水供給ポンプ
３１	合流部
４０	燃料・水噴射弁
５０	噴射弁
５２	噴射弁の本体
５４	針弁
５６	頭部
５８	内周壁
６０	燃料室
６１	燃料供給管
６２	燃料噴射孔
６３	制御装置
６４	燃料通路
６６	燃料供給装置
６８	燃料供給通路
７０	逆止調圧弁
７４	水供給通路
７６	供給孔
８０	噴射孔
８２	水通路
８４	リテーナ
８８	スプリング
９０	ストッパ部
９２	電磁弁
９４	燃料噴射ポンプ
９６	コントローラ
１００	サックボリューム
１０２	燃料溜部
１０４	供給孔
１０６	水溜部
１０８	供給孔
１１０	ナット
１１２	リテーナ

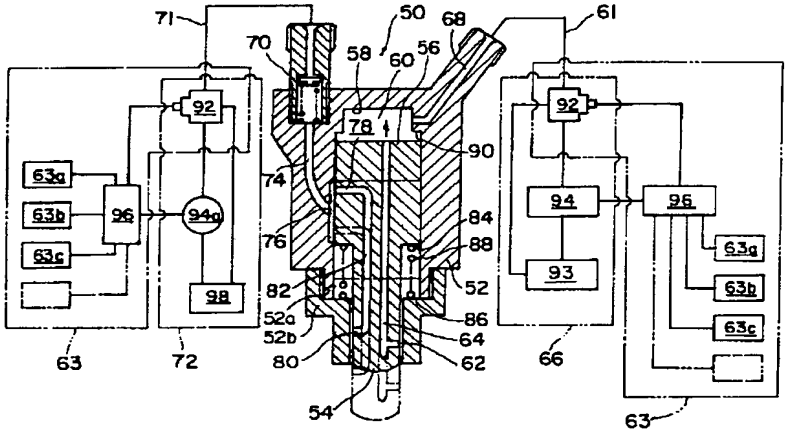
19

１１４	内室
２００	回動手段
２００ａ	回転位置可変部材
２０１	ボルト
２０２	凹部
２０３	係止蓋
２０３ａ	ボルト
２０４	ラック

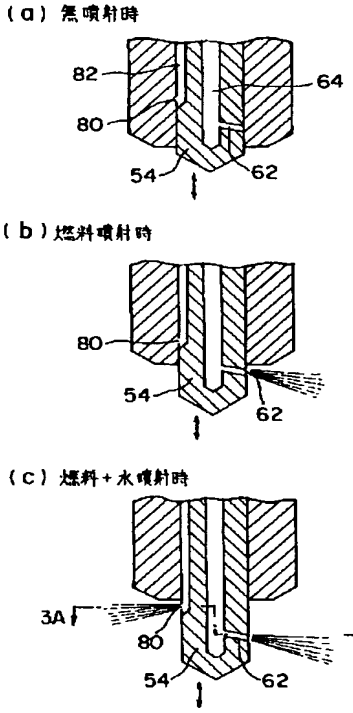
20

	＊２０５	ボルト
	２０６	ピニオンギヤ
	Ｈ１	燃料噴射の中心線
	Ｈ２	水噴射の中心線又は高温燃焼部分の中心
	Ｋ	ずれ角度
	Ｋ３	ずれ角度
	Ｋ４	ずれ角度
＊	Ｓ	スワール

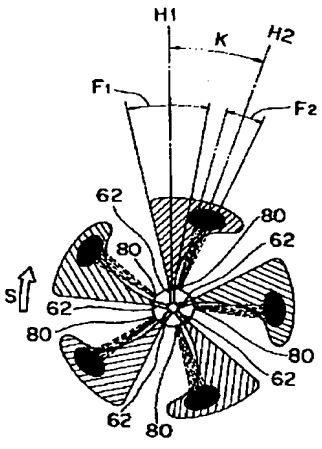
【図１】



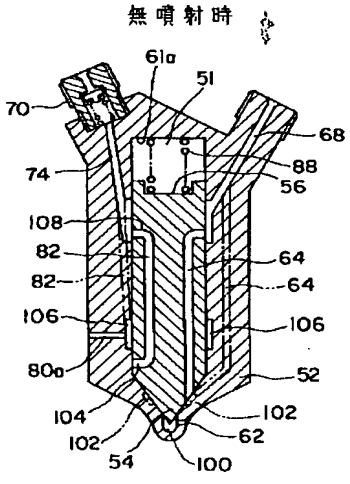
【図２】



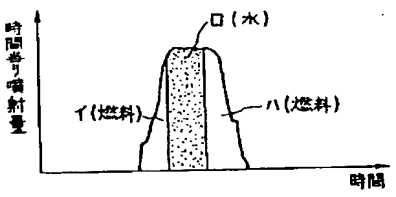
【図３】



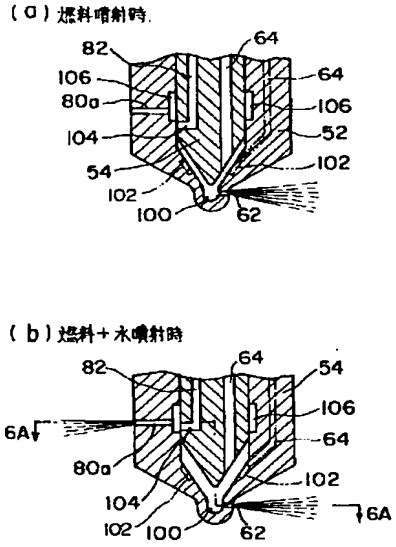
【図４】



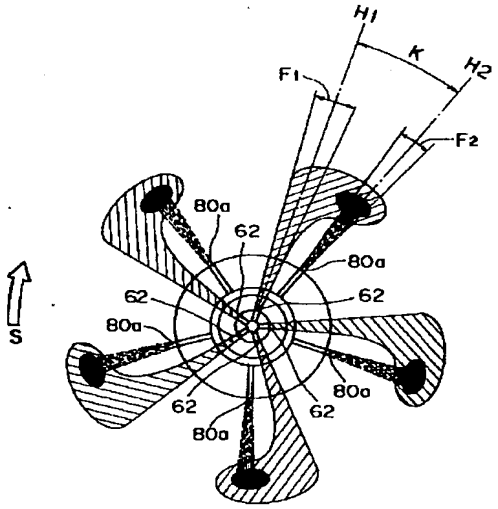
【図１１】



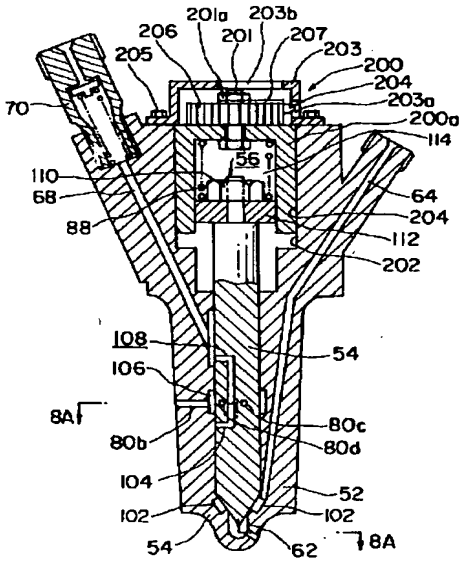
【図５】


(a) 燃料噴射時
82
64
106
80a
104
54
102
100
62
52
(b) 燃料＋水噴射時
6A
6A

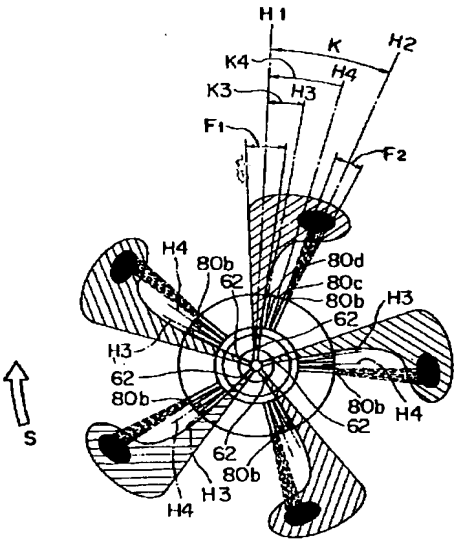
【図６】


H1
K
H2
F1
F2
S
80a
62

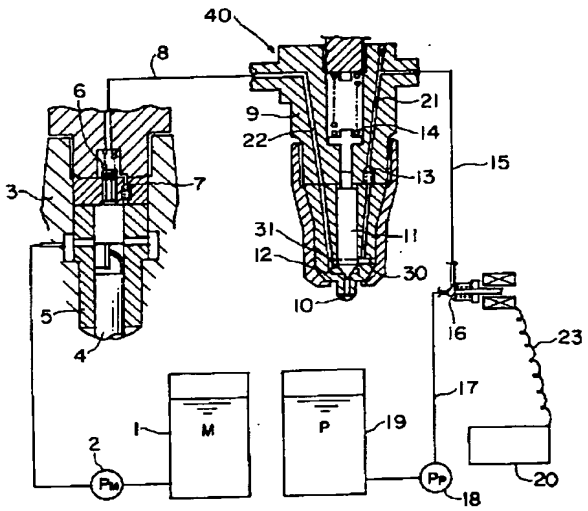
【図７】


201a
203b
206
201
207
205
203
200
204
203a
200a
114
70
56
110
68
64
204
88
112
202
108
54
106
8A
80c
80b
80d
104
52
102
102
54
62
8A

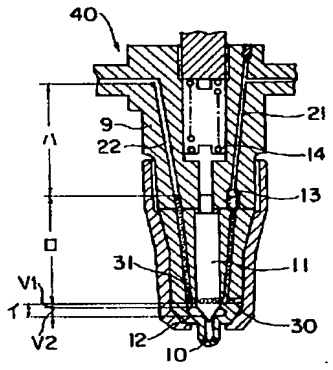
【図８】


H1
K
H2
K4
H4
K3
H3
F1
F2
S
H4
80b
62
80d
80c
80b
H3
62
H3
62
80b
80b
H4
62
62
80b
H3
H4

【図９】



【図１０】



フロントページの続き

(51)Int.Cl.'	識別記号	FI		
F02M 61/18	320	F02M	61/18	360J
	360		25/02	H
				T

(58)調査した分野(Int.Cl.', DB名)

F02M 43/04
F02B 47/02
F02D 19/12
F02M 25/022
F02M 61/10
F02M 61/18 320
F02M 61/18 360

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The needle valve which slides on the inside of the body of this injection valve in the injection valve prepared in an engine combustion chamber, The fuel nozzle which injects this fuel prepared in the above-mentioned body or this needle valve opened for free passage by the fuel path established in this body or this needle valve, and actuation of this needle valve with this fuel path, It has the water path established in this body or this needle valve, and the water-injection hole which injects this water that was opened for free passage by actuation of this needle valve with this water path, and was prepared in the above-mentioned body or the needle valve. This water-injection hole is a water-injection valve characterized by being prepared so that it directs in the downstream of the swirl generated in the above-mentioned combustion chamber from the fuel-injection location to which the above-mentioned fuel nozzle points, and it is injected from the above-mentioned fuel nozzle, and it may burn and this water may be injected by the part which flame propagation is carried out and is carrying out elevated-temperature combustion.
[Claim 2] The water-injection valve according to claim 1 characterized by being constituted so that this fuel nozzle may carry out opening first and this water-injection hole may subsequently carry out opening by actuation of the needle valve of the above-mentioned injection valve, while the above-mentioned fuel nozzle and a water-injection hole are prepared respectively independently in the injection valve of ** -.
[Claim 3] The water-injection valve according to claim 1 or 2 characterized by what the range of a gap include angle with this water-injection include angle to whenever [this fuel spray angle] was constituted for by 45 abbreviation [15 -] while this water-injection hole consists and is prepared in this fuel nozzle and spacing in the plane of projection of the cross section of this injection valve.
[Claim 4] The above-mentioned fuel path formed in this needle valve that - edge is opened for free passage by the combustion chamber formed by the inner circle wall of this needle valve and this body, and is opened for free passage with the fuel nozzle by which the other end was prepared in this needle valve, The water-injection hole with which it was open for free passage with the hole with the water supply path where - edge was established in this body, and the other end was prepared in this needle valve, and the water path established in this needle valve opened for free passage, The water-injection valve according to claim 1 to 3 which is equipped with the elastic member energized in the direction in which it is prepared between this needle valve and this body, and this needle valve closes the above-mentioned fuel nozzle and a water-injection hole, and is characterized by **.
[Claim 5] The water-injection valve according to claim 4 characterized by establishing this water path in this body.
[Claim 6] The fuel nozzle prepared in the point of this body that opens and closes by actuation of this needle valve, and is opened for free passage, The fuel path opened for free passage by the above-mentioned fuel-supply path where it was open for free passage to the fuel reservoir where - edge was established in the contact section of this needle valve and the inner circle wall of this body, and the other end was prepared in the above-mentioned body, This water-injection hole prepared in this body of an upper part location from this fuel nozzle, and this water path

established in this needle valve to which this water supply path where - edge was established in the above-mentioned body is open for free passage, and the other end has feed holes in the location between this fuel nozzle and this water-injection hole, The water-injection valve according to claim 1 to 3 characterized by having the elastic member which is prepared between this needle valve and the above-mentioned body, and energizes this needle valve in the direction which closes the above-mentioned fuel nozzle and a water-injection hole.

[Claim 7] The water-injection valve according to claim 6 characterized by establishing this fuel path in this body.

[Claim 8] Two or more water-injection holes prepared in this body so that the gap include angles of the injection direction of this above-mentioned fuel nozzle and this water-injection hole might differ, A water-injection valve given in either of the claim holes 1, 2, 6, and 7 characterized by having the rotation means of this needle valve that makes this needle valve rotate focusing on the axis of this needle valve, and you choose [needle valve] the feed holes of the above-mentioned water path, and these two or more water-injection holes, and makes it open for free passage.

[Claim 9] The rotation means of the above-mentioned needle valve is a water-injection valve according to claim 8 characterized by being formed by the rotation location variant part material constituted with the rack which has the pinion gear prepared in the head of this needle valve, and engages with this pinion gear.

[Claim 10] the diesel power plant which offered the injection valve on the engine combustion chamber -- it being and with the needle valve which slides on the inside of the body of this injection valve The fuel nozzle which injects this fuel prepared in the above-mentioned body or this needle valve opened for free passage by the fuel path established in this body or this needle valve, and actuation of this needle valve with this fuel path, The water path established in this body or this needle valve, and the water-injection hole which injects this water that was opened for free passage by actuation of this needle valve with this water path, and was prepared in the above-mentioned body or the needle valve, The fuel supply system connected to the above-mentioned fuel path, and the water feeder connected to the above-mentioned water path, It has the control unit which controls the above-mentioned amount of water injection by the input of this at least one signal of ambient temperature, such as a crank angle signal of the above-mentioned engine, a load signal and atmospheric temperature, a circulating water temperature, and engine room temperature, at least. The injection direction of this water-injection hole is a diesel power plant with a water-injection valve which the fuel which directed in the above-mentioned downstream from the fuel-injection location to which the above-mentioned fuel nozzle points, and was injected from the above-mentioned fuel nozzle burns, and flame propagation is carried out and is characterized by being prepared so that this water may be injected by the part which is carrying out elevated-temperature combustion.

[Claim 11] The diesel power plant with a water-injection valve according to claim 10 characterized by preparing independently this fuel injection valve that has only the above-mentioned fuel nozzle, and this water-injection valve that has only a water-injection hole, respectively.

[Claim 12] It is the diesel power plant with a water-injection valve according to claim 10 or 11 characterized by being constituted so that water injection may not be performed at the time of the above-mentioned ambient temperature of this engine that cannot be lit easily, but it may be controlled by the above-mentioned control unit from the time of the inside load of this engine at the time of a heavy load, the above-mentioned fuel injection and water injection may be performed and it may burn continuously at the time of a low load at the time of idle rotation at the time of starting of this engine.

[Claim 13] The injection quantity of this water responds to this engine load, and is 0 thru/or the diesel power plant with a water-injection valve according to claim 10 to 12 preferably characterized by 40 thru/or being constituted so that it may be controlled by the above-mentioned control unit to be injected 60% 60% to 100% of fuels.

[Translation done.]

.* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the diesel power plant with a water-injection valve and a water-injection valve which injects water and a fuel.
[0002]
[Description of the Prior Art] In order to reduce the nitrogen oxides (NOx) in the exhaust gas of a diesel power plant, it is common knowledge that the diesel power plant injected independently in water in a combustion chamber apart from a fuel in making water mix into a fuel from the former, or using an emulsion fuel is effective.
[0003] The conventional example of this kind of diesel power plant has JP,4-27757,A of for example, a water-injection diesel power plant. As a water-injection diesel power plant given [this] in JP,4-27757,A is shown in drawing 9 and drawing 10 , the water feed pump 18 is held in a predetermined period and the valve-opening condition through a control apparatus 20 during an idle period, and the water of the specified quantity is sent into the control valve 16 by the fuel and the water-injection valve 40 through the supply pipe 15.
[0004] Since it is Po>Pa and Po>Pr to the injection-valve opening pressure Po of a needle valve 11 when setting the valve-opening pressure Pa of the check valve regulator valve 7 of the body 3 of a fuel injection pump, and the injection-valve opening pressure of the check valve 13 of water to Pr at this time, the supplied water is flowing in the fuel path 22 through the water path 30 and the unification section 31 through a check valve 13. The fuel which is in an upstream, i.e., fuel injection pump 3 body, side from the unification section 31 in the fuel path 22 is put back in the direction of the body 3 of a fuel injection pump through a fuel injection pipe 8, pushes the nonreturn regulator valve 7 open, and flows backwards in a plunger room.
[0005] Consequently, as shown in drawing 10 , in the fuel water-injection valve 40, it is the volume V2 of the fuel reservoir 12. And volume V1 of the fuel path 22 from the unification section 31 to the fuel reservoir 12 V1+V2 which is the sum It is filled with a volume fuel, the water of the specified quantity is filled in the fuel path 22 of the upstream of the above-mentioned unification section 31, and it is in the condition that the fuel was filled again, in the upstream further.
[0006] When PURAJA 4 of a fuel pump goes up from this condition and compression of a fuel is started, the pressure in a fuel injection pipe 8, the fuel path 22, and the fuel reservoir 12 rises, and it is the injection-valve opening pressure P of a needle valve 11. If it becomes above, a needle valve 11 will be opened. If a needle valve 11 reaches an injection-valve opening pressure Po, like drawing 10 and drawing 11 , from the nozzle hole 10 of a fuel and the water-injection valve 40, fuel (**) of the volume (V1+V2) to the fuel reservoir 12 and the unification section in the fuel path 22 is injected first, above water (**) by which specified quantity supply was carried out will be injected continuously, and whole-quantity injection of the remaining fuel (Ha) will be carried out at the last.
[0007] Then, since the plunger 4 of the above-mentioned fuel pump descends, while the pressure in the fuel reservoir 12 descends and a needle valve 11 is closed, the idle period which does not feed the fuel by the above-mentioned plunger comes, and it has after that the structure where

.water is sent into a fuel and the water-injection valve 40 through the same stroke as the above by actuation of the water feed pump 18 explained above.
[0008]
[Problem(s) to be Solved by the Invention] However, by the nozzle hole 10 of - ** prepared in the fuel and the water-injection valve with the technique given [this] in JP,4-27757,A, as shown in drawing 10 , it will inject in the **-location of the direction of ** - in order of fuel (**), water (**), and a fuel (Ha) by one above-mentioned injection.
[0009] Therefore, the part which went up gradually and has burned at the elevated temperature is the above-mentioned downstream as the combustion temperature near [where combustion temperature was this injected] the location goes to the above-mentioned lower stream of a river by low temperature, since it is lit and flame propagation of fuel (b) injected first is carried out, the downstream passing by the swirl. Therefore, since it is turned to the place which is burning at the low temperature which is a **-location as mentioned above, HC, CO, and a black smoke will be increased as exhaust gas, and injection of water (b) will be discharged, when a possibility of carrying out a flame failure carries out a flame failure, since those with ** and fuel injection become intermittent with a fuel -> water -> fuel.
[0010] Moreover, since water (b) of the conventional fuel oil consumption (I) (+ (Ha)) and a conventional almost same amount will be injected as shown by drawing 11 , the fuel of a technique given [above-mentioned] in an official report and the fuel injection period (time amount) of water become twice [about] conventionally as compared with injection of only a fuel, and become long. Since the fuel (Ha) of the above-mentioned last will be injected at the place where the pressure in a combustion chamber began to get down at, and temperature fell when this fuel injection period (time amount) becomes long, it is hard coming to carry out this combustion, and is easy to generate combustion gas and a black smoke at last, and fuel consumption worsens further.
[0011] This invention is proposed in view of the above-mentioned technical problem, and it injects by preparing a fuel nozzle and a water-injection hole separately so that the fuel in the above-mentioned combustion chamber may be burned continuously. So that water may be injected, injecting a fuel into the above-mentioned elevated-temperature combustion part, and this combustion temperature of this elevated-temperature combustion part may be lowered and the temperature of the above-mentioned low-temperature combustion part may not be lowered as much as possible It aims at canceling the above-mentioned technical problem, as reduction can perform generating of NOx, HC, CO, and a black smoke by shifting whenever [spray angle / of this nozzle of a fuel, and a water-injection hole].
[0012]
[Means for Solving the Problem] For this reason, the water-injection valve of this invention according to claim 1 The needle valve which slides on the inside of the body of this injection valve in the injection valve prepared in an engine combustion chamber, The fuel nozzle which injects this fuel prepared in the above-mentioned body or this needle valve opened for free passage by the fuel path established in this body or this needle valve, and actuation of this needle valve with this fuel path, It has the water path established in this body or this needle valve, and the water-injection hole which injects this water that was opened for free passage by actuation of this needle valve with this water path, and was prepared in the above-mentioned body or the needle valve. It is characterized by preparing this water-injection hole so that it directs in the downstream of the swirl generated in the above-mentioned combustion chamber from the fuel-injection location to which the above-mentioned fuel nozzle points, and it is injected from the above-mentioned fuel nozzle, and it may burn and this water may be injected by the part which flame propagation is carried out and is carrying out elevated-temperature combustion.
[0013] In the configuration according to claim 1, the water-injection valve of this invention according to claim 2 is characterized by what was constituted so that this fuel nozzle might carry out opening first and this water-injection hole might subsequently carry out opening by actuation of the needle valve of the above-mentioned injection valve while the above-mentioned fuel nozzle and a water-injection hole are prepared respectively independently in the same

injection valve. In the configuration according to claim 1 or 2, in the plane of projection of the cross section of this injection valve, the water-injection valve of this invention according to claim 3 is characterized by what the range of a gap include angle with this water-injection include angle to whenever [this fuel spray angle] was constituted for by 45 abbreviation [15 -] while this water-injection hole consists and is prepared in this fuel nozzle and spacing.

[0014] The water-injection valve of this invention according to claim 4 is set in a configuration given in either of one to claim 3 claims. The above-mentioned fuel path formed in this needle valve that - edge is opened for free passage by the combustion chamber formed by the inner circle wall of this needle valve and this body, and is opened for free passage with the fuel nozzle by which the other end was prepared in this needle valve, The water-injection hole with which it was open for free passage with the hole with the water supply path where - edge was established in this body, and the other end was prepared in this needle valve, and the water path established in this needle valve opened for free passage, having had the elastic member which is prepared between this needle valve and the wall of this body, and energizes this needle valve in the direction which closes the above-mentioned fuel nozzle and a water-injection hole -- the description -- **** .

[0015] The water-injection valve of this invention according to claim 5 is characterized by establishing this water path in this body in the configuration according to claim 4. The water-injection valve of this invention according to claim 6 is set in a configuration according to claim 1 to 3. The fuel nozzle prepared in the point of this body that is opened and closed by actuation of this needle valve and is opened for free passage with the above-mentioned fuel path, The above-mentioned fuel path where it was open for free passage to the fuel reservoir where - edge was established in the contact section of the point of this needle valve, and the inner circle wall of this body, and the other end was prepared in the above-mentioned body, and the fuel path opened for free passage by the above-mentioned fuel-supply path opened for free passage, This water-injection hole prepared in this body of an upper part location from this fuel nozzle, and this water path established in this needle valve to which this water supply path where - edge was prepared in the above-mentioned body is open for free passage, and the other end has feed holes in the location between this fuel nozzle and this water-injection hole, It is characterized by having the elastic member energized in the direction in which it is prepared between this needle valve and the above-mentioned body, and this needle valve closes the above-mentioned fuel nozzle and a water-injection hole.

[0016] The water-injection valve of this invention according to claim 7 is characterized by establishing this fuel path in this body in the configuration according to claim 6. This water-injection valve of this invention according to claim 8 is set in a configuration given in either of claims 1, 2, 6, and 7. It is characterized by having two or more water-injection holes prepared in this body so that these gap include angles of the injection direction of this fuel nozzle and a water-injection hole might differ, and the rotation means of this needle valve that makes this needle valve rotate focusing on the axis of this needle valve, and you choose [needle valve] the above-mentioned water feed holes and these two or more water-injection holes, and makes it open for free passage.

[0017] The water-injection valve of this invention according to claim 9 is characterized by forming the rotation means of the above-mentioned needle valve by the rotation location variant part material constituted with the rack which has the pinion gear prepared in the head of this needle valve, and engages with this pinion gear in the configuration according to claim 8. The diesel power plant with a water-injection valve of this invention according to claim 10 The needle valve which slides on the inside of the body of this injection valve in the diesel power plant which offered the injection valve on the combustion chamber, The fuel nozzle which injects this fuel prepared in the above-mentioned body or this needle valve opened for free passage by the fuel path established in this body or this needle valve, and actuation of this needle valve with this fuel path, The water path established in this body or this needle valve, and the water-injection hole which injects this water that was opened for free passage by actuation of this needle valve with this water path, and was prepared in the above-mentioned body or the needle valve, The fuel supply system connected to the above-mentioned fuel path, and the water feeder connected to

.the above-mentioned water path, It has the control unit which controls the above-mentioned amount of water injection by the input of this at least one signal of ambient temperature, such as a crank angle signal of the above-mentioned engine, a load signal and atmospheric temperature, a circulating water temperature, and engine room temperature, at least. The fuel which pointed to the injection direction of this water-injection hole in the above-mentioned downstream from the fuel-injection location to which the above-mentioned fuel nozzle points, and was injected from the above-mentioned fuel nozzle burns, and flame propagation is carried out and it is characterized by being arranged so that this water may be injected by the part which is carrying out elevated-temperature combustion.

[0018] The diesel power plant with a water-injection valve of this invention according to claim 11 is characterized by preparing independently this fuel injection valve that has only the above-mentioned fuel nozzle, and this water-injection valve that has only a water-injection hole, respectively in the configuration according to claim 10. The diesel power plant with a water-injection valve of this invention according to claim 12 In a configuration according to claim 10 or 11, water injection is not performed at the time of the above-mentioned ambient temperature of this engine that cannot be lit easily at the time of a low load at the time of idle rotation at the time of starting of this engine. It is characterized by being constituted so that it may be controlled by the above-mentioned control unit from the time of the inside load of this engine at the time of a heavy load, the above-mentioned fuel injection and water injection may be performed and it may burn continuously.

[0019] the diesel power plant with a water-injection valve of this invention according to claim 13 -- a configuration according to claim 10 to 12 -- setting -- the injection quantity of this water -- this engine load -- responding -- 100% of fuels -- receiving -- 0 -- or it is preferably characterized by 40 thru/or being constituted so that it may be controlled by the above-mentioned control unit to be injected 60% 60%.

[0020]

[Function] With the water-injection valve of above-mentioned this invention according to claim 1 **, the above-mentioned fuel nozzle, and a water-injection hole are separately prepared in the injection valve prepared in this combustion chamber. Since it is constituted making the combustion part which flame propagation is carried out to the downstream of the swirl which the fuel injected from this fuel nozzle is lit, and is generated in the above-mentioned combustion chamber, and has become an elevated temperature inject this fuel so that water can be injected from this water-injection hole, this combustion can burn continuously.

[0021] While injecting this water and lowering the combustion temperature of this elevated-temperature combustion part, making this elevated-temperature combustion part inject the above-mentioned fuel since the nozzle hole of a fuel and the nozzle of water were shifted as mentioned above, water is not injected into the abbreviation low-temperature combustion part of this combustion, but it can avoid lowering temperature. moreover -- since the above-mentioned water injection is performed as mentioned above at the stage of a request of an injection term [of this fuel] throughout -- this fuel fuel injection period -- ** -- it does not become long

[0022] Therefore, in this invention, discharge of HC, CO, and a black smoke can be reduced effectively. With the water-injection valve of this invention according to claim 2, this fuel nozzle and a water-injection hole are arranged in the above-mentioned injection valve of ** - respectively independently, and by actuation of the needle valve of this injection valve, since it constituted so that this fuel nozzle might carry out opening first and this water-injection hole might carry out opening after that, water can be injected by this one injection valve at the stage of a request while injecting the above-mentioned fuel.

[0023] Therefore, without carrying out the flame failure of the above-mentioned combustion, discharge of HC, CO, and a black smoke can be reduced and cost can form a cheap and compact water-injection valve. With the water-injection valve of this invention according to claim 3, the gap angle of this spray angle of this fuel nozzle and this water-injection hole is constituted by 15 - 45 ****, since water injection can be exactly carried out to the part which has burned at the above-mentioned elevated temperature with this fuel by which precedence injection was carried out, without carrying out a flame failure, the temperature of this elevated-temperature

.combustion part can be lowered, and generating of NOx can be reduced.
[0024] With claim 4 and the water-injection valve of this invention according to claim 5, since prepare a combustion chamber between this head of this needle valve, and this body inner circle wall, and resist the above-mentioned elastic member with the pressure of the fuel supplied to this combustion chamber, this needle valve is made to operate, opening of this fuel nozzle is carried out and it was subsequently made to carry out opening of this water-injection hole, it is formed in a compact and injection of a fuel and water can carry out easily.
[0025] This needle valve opens and closes both the above-mentioned nozzles smoothly, and since it constituted from a claim 6 and a water-injection valve of this invention according to claim 7 so that opening of the nozzle of the above-mentioned fuel and water might be carried out, when the above-mentioned fuel nozzle and a water-injection hole were prepared in this body and this needle valve operated the inside of this body up, and receipts and payments of this needle valve to this combustion chamber were lost, the inside of this body is guided certainly, and the thing of it can be carried out.
[0026] With claim 8 and the water-injection valve of this invention according to claim 9 Since this needle valve is made to rotate with these two or more water-injection holes prepared in this body, and the rotation means of the above-mentioned needle valve so that the above-mentioned gap angles of the injection direction of this ****** to this fuel nozzle may differ and it was made to make the water feed holes and the selection target of the above-mentioned needle valve open for free passage Since the temperature of this elevated-temperature combustion part can be lowered without performing and carrying out the flame failure of this water injection to the above-mentioned elevated-temperature combustion part which changes according to the condition of this engine load or the above-mentioned swirl exactly, generating of NOx can be reduced effectively.
[0027] By the diesel power plant with a water-injection valve according to claim 10 The fuel supply system connected to the above-mentioned fuel path, and the water feeder connected to the above-mentioned water path, It consists of a control unit which controls the above-mentioned amount of water injection by the input of this at least one signal of ambient temperature, such as a crank angle signal of the above-mentioned engine, a load signal and atmospheric temperature, a circulating water temperature, and engine room temperature, at least. It points to the injection direction of this water-injection hole in the above-mentioned downstream from the fuel-injection location to which the above-mentioned fuel nozzle points. And the fuel injected from the above-mentioned fuel nozzle burns, and since it has the water and the fuel injection equipment constituted so that this water injection might be carried out to the part which flame propagation was carried out and has burned at the elevated temperature while being able to perform exactly the injection quantity of the above-mentioned water and a fuel, the injection direction, and fuel injection timing, without it carries out a flame failure -- good combustion -- ****** -- things are made.
[0028] By the diesel power plant with a water-injection valve of this invention according to claim 11, by the water-injection diesel power plant, since this fuel injection valve and the water-injection valve were prepared separately, when arranging in this combustion chamber, there is a degree of freedom which can set up uniquely the above-mentioned relative position of this water-injection hole to this fuel nozzle, and the effective above-mentioned water injection can be performed. By the diesel power plant with a water-injection valve of this invention according to claim 12 or 13 With the above-mentioned control unit arranged by the above-mentioned fuel injection equipment and the water injection system The amount of water and this water-injection period of this water injection are controlled, and water injection is not performed at the time of the above-mentioned ambient temperature of this engine that cannot be lit easily at the time of a low load at the time of idle rotation at the time of starting of this engine. Since water injection was made to be performed with the above-mentioned fuel injection at the time of the inside load of this diesel power plant, and a heavy load While being able to perform exactly the injection quantity of the above-mentioned water and a fuel, the injection direction, and fuel injection timing, without carrying out the flame failure of the above-mentioned combustion, generating of NOx, HC, CO, and a black smoke can be reduced effectively, without reducing engine power.

[0029]
[Example] The example of this invention is explained about drawing 1 -8.
Drawing 1 -3 are what shows the 1st example of this invention. (The 1st example) The explanatory view of the fuel and water injection system with which drawing 1 was equipped with the injection valve of this invention, and drawing 2 are the explanatory views showing the operating state of the nozzle of the water-injection valve of this invention. The explanatory view near the nozzle in which (a) shows the condition of this injection valve of not injecting, the explanatory view in which (b) shows the fuel-injection condition of this injection valve, and (c) are the explanatory views showing the condition of having injected the fuel and water of this injection valve to coincidence.
[0030] Drawing 3 is the explanatory view showing the relation of whenever [spray angle / of a fuel and water] by the injection valve of the 1st example. As shown in drawing 1 , the water-injection valve 50 is connected to the fuel and the water injection system which consists of the fuel supply system and water feeder which were prepared through the control unit which controls the injection quantity of the above-mentioned fuel and water, fuel injection timing, the injection direction, etc.
[0031] The water-injection valve 50 is formed from the needle valve 54 held when it was fitted in a body 52 free [sliding] and attachment component 52b carried out screwing conclusion at screw section 52a of the lower limit of a body 52, and the combustion chamber 60 formed by the head 56 of - one end, and the inner circle wall 58 of a body 52. The fuel path 64 where - edge is opened for free passage by drawing 1 at at a combustion chamber 60 as the continuous line showed, and the other end is opening for free passage the condition that both injections of the above-mentioned fuel and water have stopped, to the fuel nozzle 62 of a needle valve 54 is established in the needle valve 54.
[0032] Moreover, the fuel-supply path 68 - edge is opened [fuel supply] for free passage by the combustion chamber 60 and the other end is connected [fuel supply / combustion chamber] by the fuel supply system 66 through the supply pipe 61 and the control unit 63 is established in the body 52. Moreover, the water supply way 74 which is open for free passage to the water feeder 72 through the nonreturn pressure regulating valve 70, a supply pipe 71, and a control unit 63 is established in the body 52.
[0033] Moreover, it has the feed holes 76 of the water supply way 74, and the feed holes 78 open for free passage at - edge, and the water path 82 which is open for free passage to the water-injection hole 80 prepared in the other end at the needle valve 54 is established in this needle valve 54. The needle valve 54 was energized in the direction in which the fuel nozzle 62 and the water-injection hole 80 are blockaded, and is in contact with the stopper section 90 in a combustion chamber 60 with the spring 88 which is the elastic body infixed between the retainer 84 prepared in the inferior surface of tongue of the head 56 of this needle valve 54, and the retainer 86 prepared in the step of the inner circumference of a body 52.
[0034] Moreover, while the control unit 63 of the above-mentioned fuel is connected to the solenoid valve 92 and fuel injection pump 94 which were formed in the fuel feeding pipe 61 The signal from ambient temperature sensor 63c of these engines, such as a circulating water temperature of sensor 63a, load sensor 63b of this engine, and this engine, temperature of an engine room, and atmospheric temperature, etc. is inputted whenever [crank angle / of a diesel power plant], and a control signal is outputted to the above-mentioned fuel injection pump 94 and a solenoid valve 92. It consists of controller 96 grades which control the fuel amount of supply and fuel injection timing.
[0035] That to which the method of - and the above-mentioned water control unit 63 are also different from the control unit 63 of the above-mentioned fuel is replaced with a fuel injection pump 94, and is only water booster-pump 94a, and other configurations are **- substantially. Water booster-pump 94a of this example is also replaceable with the water ejector 94 of a configuration as well as a fuel injection pump 94.
[0036] A solenoid valve 92, booster-pump 94a, etc. are controlled and determined by this amount of water injection and this fuel injection timing inputting the signal from each above-mentioned sensors 63a, 63b, and 63c, ..., etc. into a controller 96, and outputting them as a control signal.

Here, a diesel power plant operates, a heavy load is inputted into at least one signal from above-mentioned load sensor 63b, above-mentioned ambient temperature sensor 63c, etc. by the control device 63 shown in drawing 1 from crank angle sensor 63a of a diesel power plant, and the inside load of an engine, a fuel injection pump 94 and solenoid-valve 92 grade are controlled, and the fuel of a fuel tank 93 is supplied to a combustion chamber 60 through a supply pipe 61 and the fuel-supply path 68 by the fuel injection pump 94.

[0037] Since the fuel nozzle 62 will be opened as a needle valve 54 resists the energization force of a spring 98, a needle valve 54 descends and it was shown in drawing 2 (b) if the pressure of a combustion chamber 60 rises from the valve-opening set pressure of a needle valve 54, a fuel is injected. Moreover, in drawing 2 , although it indicated that the fuel nozzle 62 and the water-injection hole 80 had spacing of 180 degrees mutually on account of explanation, the relation of both this spray angle is as the gap angle K as shown in drawing 3 .

[0038] As mentioned above, in this example, although the fuel and the water injection system which controls the injection quantity and fuel injection timing of the fuel of the above-mentioned fuel supply system and a water feeder and water by the above-mentioned control unit were explained, it is not limited to this and the equipment which coordinates with an accelerator pedal and a machine target and controls the above-mentioned injection quantity and fuel injection timing is also contained. This relation is the same also in the 2nd and 3rd below-mentioned examples.

[0039] As this fuel nozzle 62 was shown in drawing 3 , the fuel nozzle (62) is prepared in the point of a needle valve 54 by abbreviation regular intervals, and when it is this example, five fuel nozzles are prepared. Although flame propagation is gradually carried out in the direction S of a swirl generated in the combustion chamber which is not illustrated and it burns while a fuel is injected like F1 and lit from this fuel nozzle 62 as a slash shows to drawing 3 , the part F2 which has burned at the elevated temperature is the part H2 of the downstream of the above-mentioned swirl S from the location where the above-mentioned fuel was injected.

[0040] Furthermore, as the pressure of a combustion chamber rises and the needle valve 54 showed the two-dot chain line and drawing 2 (c) of drawing 1 R> 1 If it slides caudad and the water-injection hole 80 opens, the water which the water in a water tank 98 is controlled by the above-mentioned control unit 63, and is supplied through the water supply pipe 71, the check valve 70, the water supply path 74, and the water path 82 from the above-mentioned water feeder 72 Part F2 which has burned at the above-mentioned elevated temperature It directs in a direction and is injected from the water-injection hole 80 prepared in the downstream of a fuel nozzle as shown in drawing 3 .

[0041] So that it may shift to each of the five above-mentioned fuel nozzles 62 and angle K (gap angle of the center line H2 of the water-injection hole 80 to fuel nozzle 62 center line H1) may consist, as shown in drawing 3 Since the water-injection hole 80 is formed in **** spacing and water injection is performed, water injection is performed into the part which has burned in this elevated-temperature section, while temperature falls and burns, without carrying out a flame failure, it continues burning in the direction of swirl S, and good combustion is performed.

[0042] The combustion temperature of the part which is formed in 45 abbreviation [15 -] according to the condition of engine magnitude or the desired swirl S, therefore has burned at this elevated temperature can fall exactly, and the gap include angle K of this spray angle can reduce generating of NOx, HC, CO, and a black smoke. Next, a solenoid valve 92 and a fuel injection pump 94 are controlled by actuation of a control unit 63, and if fuel discharge quantity decreases, the return head 56 will stop in contact with a stopper 90 by the energization force of a spring 88 in the direction which the needle valve 54 showed to drawing 1 as the continuous line.

[0043] At this time, supply of the water feeder 72 to water is also intercepted by control of a control unit 63, and 1 cycle of injection of return, water, and a fuel also ends supply of water in the condition of drawing 2 (a) by it. NOx, HC, CO, and a black smoke can be reduced effectively, without the repeat of this cycle being performed by a low load, an inside load, and the heavy load during actuation from starting of this engine, and reducing engine power.

[0044] Moreover, if the above-mentioned load sensor 63b detects no-load [of this engine], a

.low load, and idle rotation or engine ambient temperature sensor 63c detects the temperature below ignition temperature, since the above-mentioned water feeder 72 will not operate, this water injection is not performed. On the other hand, when not injecting this water, the above-mentioned fuel is supplied to a combustion chamber 60 from a fuel pump 94 like the above, but since it is controlled by the control unit 63 and a needle valve 54 descends only to the location of drawing 2 (b) at this time, only the gas oil which is a fuel is injected and actuation of this good engine is performed.

[0045] Furthermore, since the location which a needle valve 54 descends and is shown in the two-dot chain line of drawing 1 and drawing 2 (c) will be arrived at if the fuel of a fuel tank 93 is supplied to this combustion chamber 60 by the fuel pump 94 and a pressure rises, water injection and fuel injection are performed to coincidence as mentioned above. Next, the case where it applies to other injection valves in which form differs from the above-mentioned example is explained.

[0046] (The 2nd example) The 2nd example is explained about drawing 4 -6. A **-sign is attached and explained to the 1st example of the above, and a **-part. As shown in drawing 4 , the fuel nozzle 62 is formed in the condom volume 100 at the tip of the valve body 52 by five abbreviation regular intervals like the 1st example.

[0047] This fuel nozzle 62 is constituted so that the fuel path 64 which was established in the point of a body 52 and was established in the needle valve 54 (or body 52 shown in drawing 4 with the two-dot chain line) may be open for free passage through fuel **** 102 and the condom volume 100 with closing motion of a needle valve 54. Furthermore, it connects with the fuel-supply path 68, and the fuel path 64 is connected to the control unit 63 of the 1st example, and the fuel supply system 66 through the supply pipe 61.

[0048] Moreover, water-injection hole 80a is prepared in this body through the upper sump section 106 from the feed holes 104 of the water path 82 which is the upper part of the fuel nozzle 62, and was established in the above-mentioned needle valve 54. Moreover, the needle valve 54 is constituted so that the fuel nozzle 62 and water-injection hole 80a may be closed by the energization force of the spring 88 infixed between the head 56 of a needle valve 54, and wall 61a of ** 51 of a body 52.

[0049] The water supply path 74 established in the body 52 is open for free passage, and the feed holes 108 of the water path 82 are connected to the supply pipe 71 of the 1st example, the control unit 63, and the water feeder 72 through the check valve 70. By the case where this engine has stopped drawing 4 , both a fuel and water show the condition at the time of no injecting.

[0050] If this engine operates, a fuel is supplied to the fuel reservoir 102 through a supply pipe 61, the fuel-supply path 68, and the fuel path 64 from a fuel supply system 66 and the pressure of the fuel reservoir 102 becomes high from the valve-opening set pressure of a needle valve 54 Since the energization force of a spring 88 is resisted and it moves up, as shown in drawing 5 (a) This fuel minds the condom volume 100 and it is F1 to drawing 6 like [nozzle / 62 / fuel] the 1st example of the above. As shown, it is injected, and lights and flame propagation is carried out in the direction of swirl S, and it is the elevated-temperature combustion part F2. It has generated.

[0051] - direction, if the pressure of the fuel reservoir 102 rises further, a needle valve 54 will go up and feed holes 104 will be opened for free passage with the sump section 106. Since water is supplied to the sump section 106 through the water supply pipe 71, the check valve 70, the water supply path 74, and the water supply path 82 from the water feeder 72 like the 1st example at this time, as shown in drawing 5 (b) and drawing 6 towards the above-mentioned elevated-temperature combustion part F2, water injection is performed like the 1st example of the above from water-injection hole 80a.

[0052] Without carrying out a flame failure, while the temperature of this elevated-temperature combustion part F2 falls and generating of NOx, a black smoke, and HC and CO is reduced, during actuation of this engine, this above-mentioned injection cycle is controlled by the above-mentioned control unit, and is repeated continuously. Then, since the fuel supply from a fuel supply system 66 will be suspended if the switch which this engine does not illustrate is turned

.off, the pressure of the fuel reservoir 102 falls and a needle valve 54 returns to the condition which it descended by the energization force of a spring 88, the fuel nozzle 62 and water-injection hole 80a were closed, and injection of water and a fuel was stopped, and showed in drawing 4 .

[0053] Moreover, when ambient temperature of the low load of this engine, and the time of idle rotation or the above-mentioned engine cannot light easily, water injection is not performed by control of the above-mentioned control unit 63 like the 1st example. the 1st and 2nd example of the above -- the gap include angle of whenever [above-mentioned water-injection and fuel spray angle] - although set as the law, the injection valve which made this gap include angle adjustable is explained as the 3rd example.

[0054] (The 3rd example) The 3rd example is explained according to drawing 7 and drawing 8 . First, although the rotation means of this needle valve of this example is explained, the same sign is substantially given to the part of ** - with both the above-mentioned examples, and it explains. As the above-mentioned gap include angle K of the above-mentioned fuel nozzle 62 and water-injection hole 80b shows drawing 7 and drawing 8 So that it may become the small gap include angles K3 and K4 from the gap include angle K of water-injection hole 80b according to the condition of this swirl at the time of a low swirl Namely, the water-injection holes 80c and 80d are formed in this body so that the center line of a water-injection hole may be set to H3 and H4. This needle valve 54 is rotated with the rotation means 200 focusing on the axis of this needle valve 54, and it constitutes so that these water-injection holes 80b, 80c, and 80d may be made to open alternatively the feed holes 104 of this needle valve 54 for free passage.

[0055] Explanation of this rotation means 200 used for this example forms the retainer 112 with which the head 56 of the needle valve 54 fitted in free [sliding to the direction of an axis of a body 52] was concluded with the nut 110 in the body 52. Although this retainer 112 can slide in the vertical direction, rotation location variant part material 200a in which the room 114 was formed while holding the retainer 112 is prepared so that it cannot rotate to a needle valve 54.

[0056] This rotation location variant part material 200a is fitted in the crevice 202 established in the body 54 rotatable with the needle valve 54, and the pinion gear 206 to which the upper part of rotation location variant part material 200a engages with a rack 204 by the bolt 201 and nut 201a is being fixed. The stop lid 203 is being fixed to the upper part of a body 52 with the bolt 205 so that rotation variant part material 200a may be stopped pivotable to the above-mentioned crevice 202.

[0057] The rack 204 has become as [operate / it / from opening 203a of the stop lid 203]. Furthermore, by directing to the graduation with which the tip of an indicator 207 attached by opening 203b to the above-mentioned nut 201a of the upper part of the stop lid 203 was established in the inner circumference of the stop lid 203 and which is not illustrated shows the above-mentioned feed holes 104 and water-injection holes [80b 80c, and 80d] engagement condition.

[0058] Actuation of the rack 204 which engages with this pinion gear 206 is the device which it is controlled by said control unit 63 and can be rotated, and the pinion gear 206 rotates [this combustion chamber] with a rack 204 at the time of a low swirl, for example, water-injection hole 80c of K4 and feed holes 104 with the above-mentioned small gap include angle are open for free passage. Therefore, from the 1st and 2 examples, flame propagation is small, and at the time of the low swirl of the above-mentioned combustion chamber, from the above-mentioned example, a flame failure can be prevented while being able to prevent generating of NOx effectively, without lowering combustion temperature beyond the need, since the injection quantity is controlled by the part which has burned at the low-temperature elevated temperature a little and water injection can be performed exactly, and it can reduce generating of HC, CO, and a black smoke.

[0059] In addition, the injection valve of this invention should just be the thing of a configuration of that water injection can make it carry out to the part which other formats except having been used for the 1st and 2nd example are sufficient as, and preceded as mentioned above in short, and fuel injection was carried out, and flame propagation was carried out [can apply to the injection valve of any well-known formation conventionally, and], and has burned at the elevated

.temperature. moreover, in the above-mentioned example, although each formed the water-injection hole 80 and the fuel nozzle 62 in this one injection valve of ** -, even if it adopts water and a total of two injection valves only for the fuels of each, the same operation effectiveness is acquired.

[0060] Moreover, in each example, although infixed between a needle valve 54 and ** inside a body 52, as long as the spring 88 which is an elastic member can open and close both the above-mentioned nozzles 62 and 80, it may be infixed, for example between a needle valve 54 and the part of the exterior of a body 52.

[0061]

[Effect of the Invention] Since according to the water-injection valve of this invention of above-mentioned claim 1 this water-injection hole was prepared so that it might direct in the downstream of the above-mentioned swirl from this injection location where this fuel nozzle points to the inside of this valve body in this injection valve that consists of this needle valve fitted in possible [sliding] While being able to perform the above-mentioned water injection into the part into which this fuel injected by preceding has burned at the elevated temperature in the downstream of this swirl with the above-mentioned fuel injection, being able to lower the temperature of an elevated-temperature combustion part to it and being able to reduce NOx effectively Generating of HC, CO, and a black smoke can be prevented without carrying out a flame failure.

[0062] According to the water-injection valve of this invention of claim 2, since this fuel nozzle and this water-injection hole were prepared in the same injection valve, cost is cheap and structure can obtain easily NOx, HC, and this injection valve to which generating of a black smoke can be reduced. Since water injection can be exactly carried out to the part which the gap include angle of this injection of this water-injection hole to this fuel nozzle is constituted by 45 abbreviation [15 -], and has burned at the above-mentioned elevated temperature with this fuel by which precedence injection was carried out according to the water-injection valve of this invention of claim 3, the temperature of this elevated-temperature combustion part can be lowered without carrying out a flame failure, and generating of NOx, HC, CO, and a black smoke can be reduced.

[0063] Since according to claim 4 and the water-injection valve of this invention according to claim 5 prepare a combustion chamber between this head of this needle valve, and this body inner circle wall, and resist the above-mentioned elastic member with the pressure of the fuel supplied to this combustion chamber, this needle valve is made to operate, opening of this fuel nozzle is carried out and it was subsequently made to carry out opening of this water-injection hole, it is formed compactly and cheaply and injection of a fuel and water can be performed easily.

[0064] Since according to claim 6 and the water-injection valve of this invention according to claim 7 it constitutes so that opening of the nozzle of the above-mentioned fuel and water may be carried out, when this needle valve operates the inside of this body up, and the volume of this combustion chamber is not changed, generating of NOx, HC, and a black smoke can be prevented without reducing this engine power. These two or more water-injection holes that according to claim 8 and the water-injection valve of this invention according to claim 9 were prepared in this body so that the above-mentioned gap include angles of this ****** to this fuel nozzle might differ according to the magnitude of this engine, or the condition of the above-mentioned swirl, Since this needle valve is made to rotate with the rotation means of the above-mentioned needle valve and it was made to make the feed holes and the selection target of this water of this needle valve open for free passage Since the temperature of this elevated-temperature combustion part can be lowered without performing and carrying out the flame failure of this water injection to the above-mentioned elevated-temperature combustion part according to the condition of this engine load or the above-mentioned swirl, generating of NOx, HC, CO, and a black smoke can be reduced effectively.

[0065] The fuel supply system which was connected to the above-mentioned fuel path according to the diesel power plant with a water-injection valve according to claim 10, It consists of a control unit which controls the above-mentioned amount of water injection by the input of this

.at least one signal of ambient temperature, such as the water feeder connected to the above-mentioned water path, a crank angle signal of the above-mentioned engine, a load signal and atmospheric temperature, a circulating water temperature, and engine room temperature, at least. It points to the injection direction of this water-injection hole in the above-mentioned downstream from the fuel-injection location to which the above-mentioned fuel nozzle points. And the fuel injected by above-mentioned carrying out precedence burns, flame propagation is carried out, and the injection quantity of the above-mentioned water and a fuel, the injection direction, and fuel injection timing can be performed exactly, without carrying out the flame failure of the above-mentioned combustion, since it has the water and the fuel injection equipment constituted so that this water might be injected by the part which is carrying out elevated-temperature combustion.

[0066] Therefore, since the flame failure of the above-mentioned combustion is not carried out while being able to prevent Above NOx, HC, and CO and generating of a black smoke, improvement in the output of this engine can be aimed at. Since this fuel injection valve and this water-injection valve were prepared as this injection valve that became independent respectively according to the diesel power plant with a water-injection valve of this invention according to claim 11, the relative above-mentioned gap include angle of both the above-mentioned injection valves can be set as arbitration, and injection of the effective above-mentioned water and a fuel can be performed.

[0067] Therefore, generating of NOx, HC, CO, and a black smoke can be prevented, without carrying out the flame failure of this engine. According to the diesel power plant with a water-injection valve of this invention according to claim 12 or 13 The above-mentioned control device does not perform this water injection at the time of the above-mentioned ambient temperature of this engine that cannot be lit easily at the time of a low load at the time of idle rotation of the above-mentioned engine. At the time of a heavy load, during the above at the time of a load with the above-mentioned fuel injection Generating of NOx, HC, CO, and a black smoke can be prevented by that which can perform this water injection and which comes out, without carrying out the flame failure of this engine, adjusting this amount of water injection.

[0068] Moreover, since it is controlled by this control device so that 40 - 60% of water is preferably injected 0 to 60% to the 100% of the above-mentioned fuels by which injection is carried out, while being able to perform actuation of this stable engine, generating of NOx, HC, and a black smoke can be reduced [above-mentioned], without carrying out a flame failure, and the output of this engine can be raised.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the explanatory view showing the configuration of injection of the water and the fuel in which the 1st example of this invention is shown.
[Drawing 2] It is the explanatory view showing the operating state of the water-injection valve of drawing 1 , and the explanatory view in which (a) shows the time of no injecting, the explanatory view in which (b) shows the condition that the fuel is injected, and (c) are the explanatory views showing the condition that water and a fuel are injected.
[Drawing 3] It is the cross-sectional view which meets the 3A-3A line of drawing 2 (c), and is the explanatory view showing the injection direction of the fuel and water of this 1st example, and the gap include angle of injection of these both.
[Drawing 4] It is an explanatory view at the time of no injecting [which shows the longitudinal section of this water-injection valve that shows the 2nd example of this invention].
[Drawing 5] It is the explanatory view showing the operating state of the water-injection valve of drawing 4 , and (a) is the explanatory view showing the condition at the time of fuel injection, and (b) is the explanatory view showing the condition that water and a fuel are injected.
[Drawing 6] It is the cross-sectional view which meets the 6A-6A line of drawing 5 (b), and is the explanatory view showing the gap include angle of the injection direction of the fuel and water the 2nd example's, and these both injection direction.
[Drawing 7] It is the explanatory view showing the longitudinal section of the water-injection valve which shows the 3rd example of this invention.
[Drawing 8] The cross section which meets the 8A-8A line of drawing 7 is shown, and it is the same explanatory view as drawing 3 .
[Drawing 9] It is the explanatory view showing the configuration of conventional fuel and **** equipment.
[Drawing 10] It is drawing of longitudinal section of the fuel and water-injection valve of drawing 9 .
[Drawing 11] It is the explanatory view showing this injection situation by the fuel and water injection system of drawing 9 .
[Description of Notations]
3 Body of Fuel Injection Pump
4 Plunger
7 Nonreturn Pressure Regulating Valve
8 Fuel Injection Pipe
10 Nozzle Hole
11 Needle Valve
12 Fuel Reservoir
13 Check Valve of Water
18 Water Feed Pump
31 Unification Section
40 Fuel and Water-Injection Valve
50 Injection Valve

52 Body of Injection Valve
54 Needle Valve
56 Head
58 Inner Circle Wall
60 Combustion Chamber
61 Fuel Feeding Pipe
62 Fuel Nozzle
63 Control Unit
64 Fuel Path
66 Fuel Supply System
68 Fuel-Supply Path
70 Nonreturn Pressure Regulating Valve
74 Water Supply Path
76 Feed Holes
80 Nozzle
82 Water Path
84 Retainer
88 Spring
90 Stopper Section
92 Solenoid Valve
94 Fuel Injection Pump
96 Controller
100 Condom Volume
102 Fuel Reservoir
104 Feed Holes
106 Sump Section
108 Feed Holes
110 Nut
112 Retainer
114 Inside Room
200 Rotation Means
200a Rotation location variant part material
201 Bolt
202 Crevice
203 Stop Lid
203a Bolt
204 Rack
205 Bolt
206 Pinion Gear
H1 Center line of fuel injection
H2 The center line of water injection, or core of an elevated-temperature combustion part
K Gap include angle
K3 Gap include angle
K4 Gap include angle
S Swirl

[Translation done.]